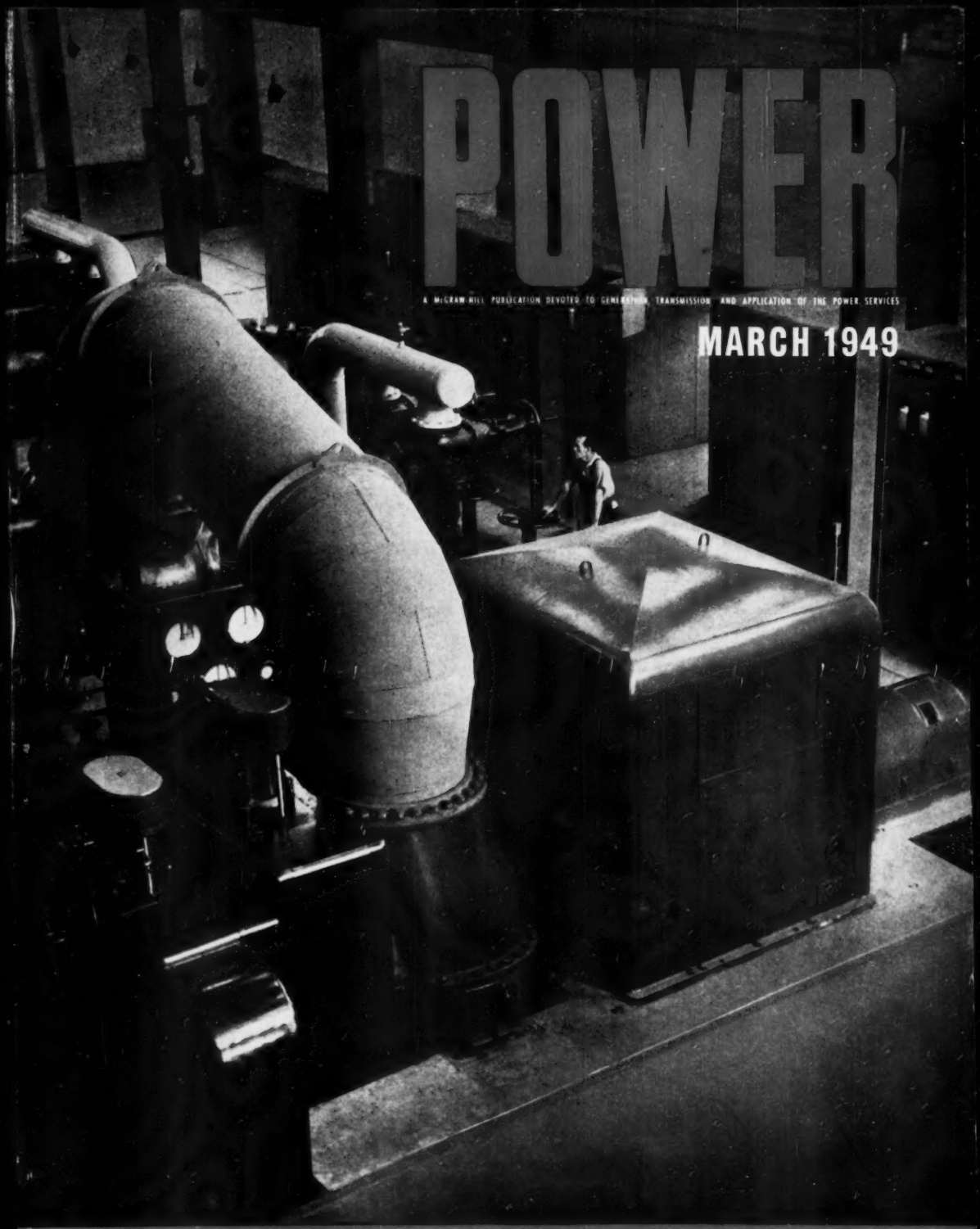
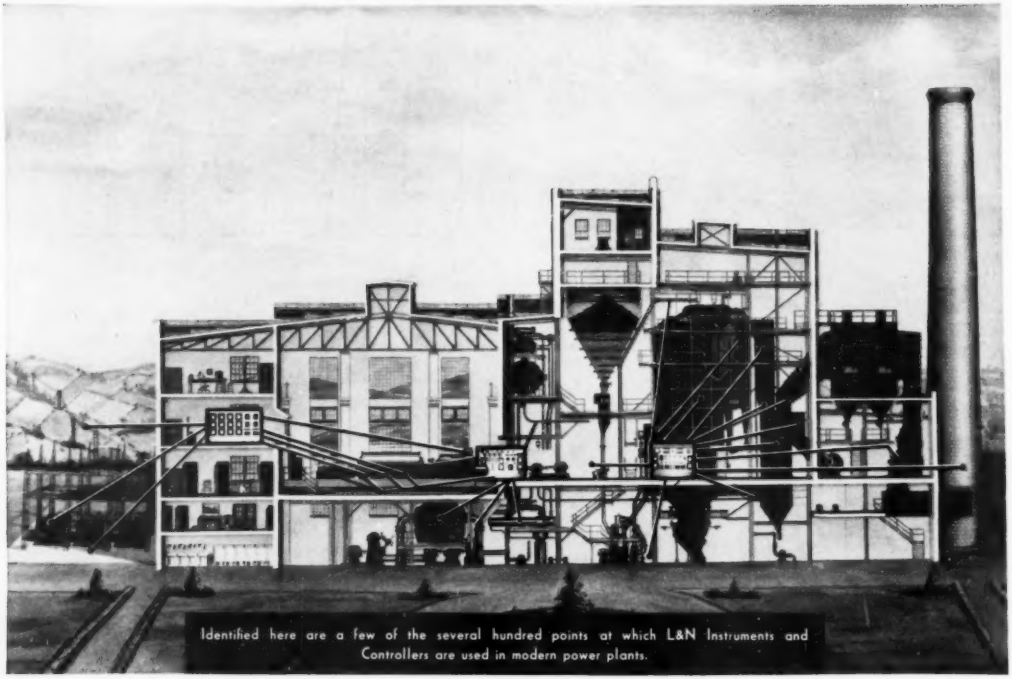


POWER

A McGRAW-HILL PUBLICATION DEVOTED TO GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

MARCH 1949

IN THIS ISSUE: Dow Chemical's new boiler is first to apply cyclone furnaces in industry, entire unit is pressurized and has no induced-draft fans, p 72; how a large hydro plant repair-welded cavitated blades in place without loss of production, p 76; simplified explanation makes ac circuit calculations easy to grasp, p 90. **CONTENTS, p 67**



Identified here are a few of the several hundred points at which L&N Instruments and Controllers are used in modern power plants.

From Fuel Bunker To Tie Line— L&N Instruments Help Power Output

From fuel bunker to switch yard and tie line, L&N offers a completeness of instrumentation unobtainable from any other single source. Recording and controlling needs may originate at both ends of the turbo-generator shaft, or anywhere along its length, and be handled by L&N instruments with outstanding ease and success.

At the steam end of the shaft are Metermax Combustion Control; Micromax Superheat Control; Micromax and/or Speedomax Recorders which give coordinated strip-chart records of all boiler and mill temperatures; recording of CO_2, smoke density, steam purity and pH.

Turbine Board Instruments

In the turbine room are Micromax strip-chart Recorders for temperatures of the feed water and condensate cycle; condenser temperatures; bearing and oil temperatures; electrolytic conductivity, and flow in connection with the Centrimax Flowmeter.

At the electric end of the shaft are Micromax and/or Speedomax Strip-Chart Recorders for temperatures in bearings, stators, fields, transformers and cables; for frequency; for remote voltage. L&N Load-Frequency Control and Load Telemetering apply to either the station or system, or both.

Complete Board Design and Construction

The trend to complete, central-control boards and cubicles has always been advocated by L&N. Highly specialized engineering and production facilities give you equipment arranged for proper operation. It reaches you assembled, wired and tested; ready for installation. You save heavily in your own time and responsibilities.

Further information will be sent on request. Address Leeds & Northrup Co., 4910 Stenton Ave., Philadelphia 44, Pa.

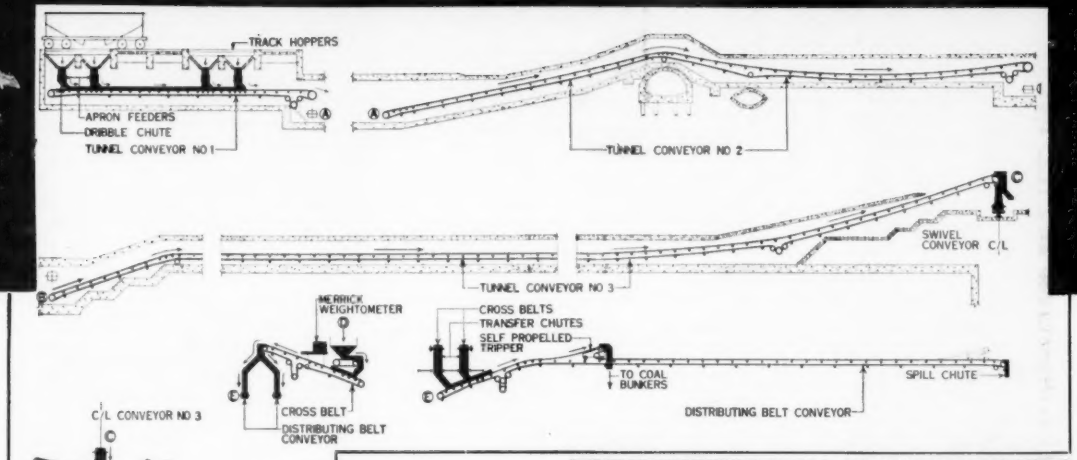
MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

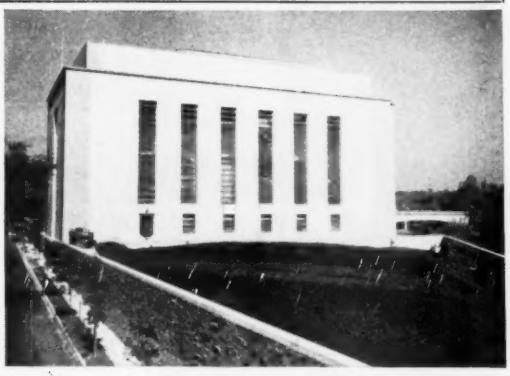
Jrl. Ad N-460 (1)

POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer" and "The Stationary Engineer," March, 1949, Vol. 93, No. 3. Published monthly with an additional Directory number in June. McGraw-Hill Publishing Company, Inc. Editorial and executive offices, 330 West 42nd Street, New York 18, N. Y. Entered as second class matter January 26, 1949, at the post office at New York, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. Subscription rates—U. S. and U. S. Possessions $5 for one year, $7 for two years, 50c per copy. Canada $6 for one year, $9 for two years. Pan American Countries, $10 for one year, $16 for two years. All other countries $15 for one year, $25 for two years. Please indicate position and company connection on all subscription orders.

Newest Capital Plant Features LINK-BELT Belt Conveyors



Top picture: West Central heating plant, with yard holding 15,000 tons of coal. *Middle:* swivel belt conveyor in yard. *Bottom:* one of the tunnel belt conveyors.



Charles H. Tompkins Co., engineers select Link-Belt handling equipment for $5,000,000 heating plant . . .

A number of problems in coal handling were solved by Link-Belt belt conveyors, selected by Chas. H. Tompkins Co., Engineers, for use at the West Central Heating Plant, 29th and K Streets, Washington, D. C., built under the direction of the Federal Works Agency.

As shown in the sketch, coal goes to apron feeders under the track hopper to tunnel belt conveyor No. 1 (82-ft. centers) . . . to tunnel belt conveyor No. 2 (198-ft. centers) . . . to tunnel belt conveyor No. 3 (250-ft. centers) . . . to swivel belt conveyor No. 4 (20-ft. centers) feeding outside storage or to breaker. Coal from breaker is elevated to belt feeders and conveyors, discharging to distributing belt conveyor over bunkers (40-ft. centers). The belt conveyor system handles 150 tons per hour.

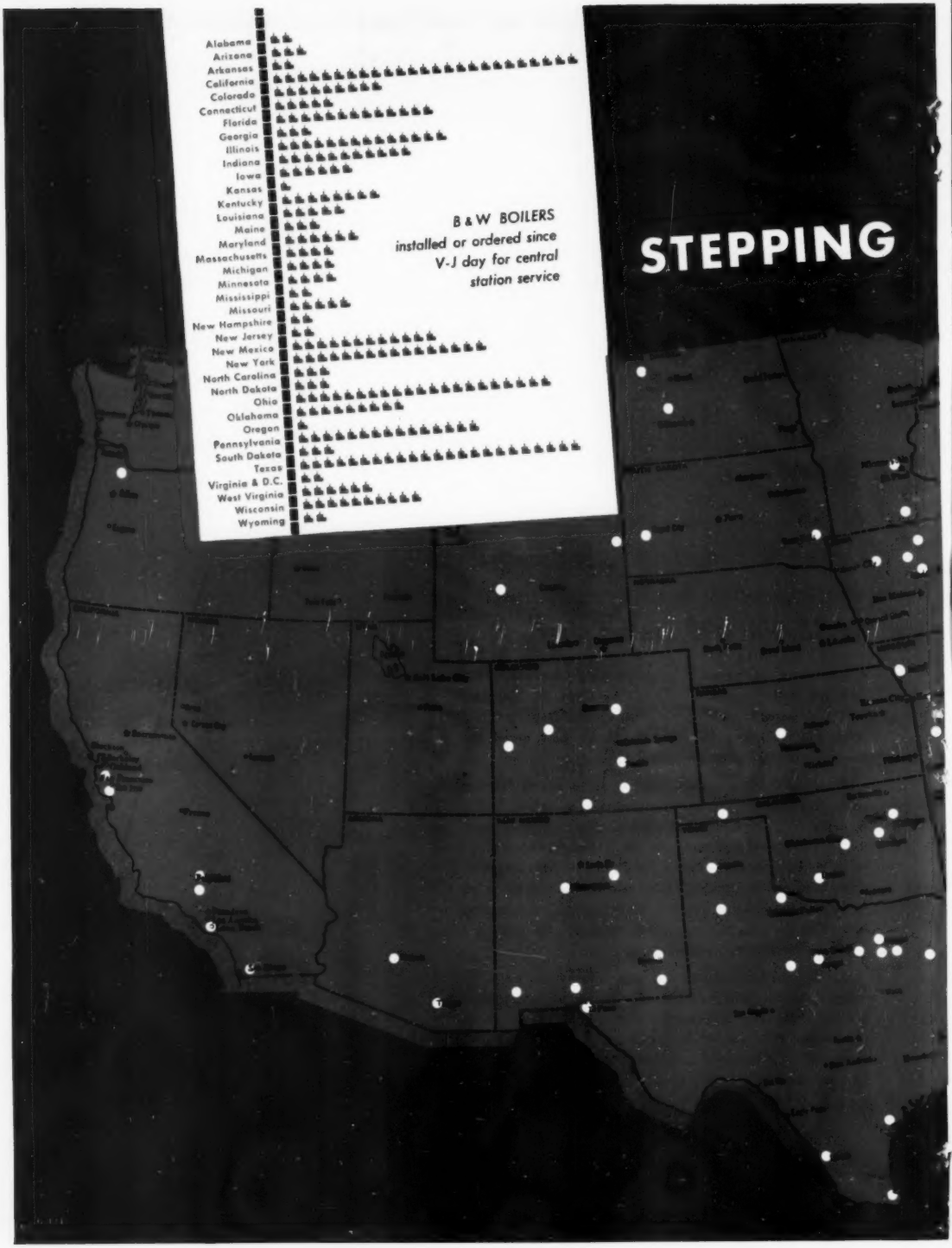
Link-Belt belt conveyors represent more than correctly designed idlers, pulleys and terminal drive machinery. They are the product of engineering experience that produces the proper relationship between pulley diameters, belt characteristics, material handled, etc. May we help you on your material handling problems?

LINK-BELT COMPANY Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities. 11.383

LINK-BELT

CONVEYING MACHINERY

"THE COMPLETE LINE"


STEPPING
B & W BOILERS
installed or ordered since
V-J day for central
station service
Alabama
Arizona
Arkansas
California
Colorado
Connecticut
Florida
Georgia
Illinois
Indiana
Iowa
Kansas
Kentucky
Louisiana
Maine
Maryland
Massachusetts
Michigan
Minnesota
Mississippi
Missouri
New Hampshire
New Jersey
New Mexico
New York
North Carolina
North Dakota
Ohio
Oklahoma
Oregon
Pennsylvania
South Dakota
Texas
Virginia & D.C.
West Virginia
Wisconsin
Wyoming

UP AMERICA'S POWER

...with B&W STEAM

America's privately-owned power companies aren't letting this nation go power-hungry. They are keeping ahead of its insatiable appetite for kilowatts by providing new steam-electric generating facilities at the greatest rate in history.

For example, dots on this map represent central stations where steam for over 9 million kilowatts of new capacity is being supplied by B&W Boilers either placed in service or ordered since V-J Day. Included in these new units are the largest central station boilers ever designed.

Nation-wide acceptance of B&W Boilers is as old as the central station industry itself. In the future as in the past, power companies can depend upon B&W for boiler designs that will continue to help supply America with adequate, dependable power at the least possible cost.

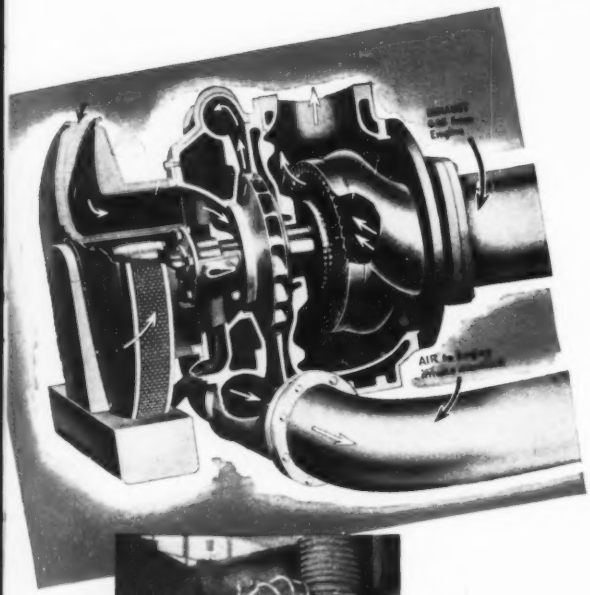
THE BABCOCK & WILCOX CO.
General Offices: 85 Liberty St., New York 6, N. Y. Works: Alliance and Barberton, O.; Augusta, Ga.

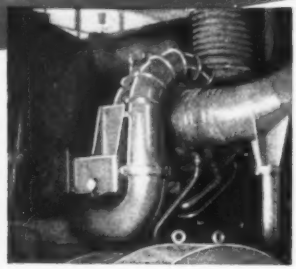
B&W

BABCOCK & WILCOX

Two ways to boost

Elliott-BUCHI TURBOCHARGERS





By close approach to the ideal in combustion and scavenging, Elliott-Buchi turbochargers increase Diesel power up to 50 percent—depending upon conditioning—and in some cases even more. All this with negligible addition to engine bulk and weight.

Driven entirely by exhaust gas from the engine, with no mechanical driving connection, the turbocharger speed is self-adjusting by the engine load. Direction of rotation remains the same whether engine is driving forward or reversing, a feature of particular importance in marine use.

Elliott-Buchi turbochargers are applied to four-cycle engines of 3 to 16 cylinders, in capacities from 250 to 3850 hp. The bulletin gives the details. Write for a copy.

Elliott

Diesel KW output

Elliott FABRI-STEEL GENERATORS

The rigidity and rugged strength of all-welded steel in stator frame and rotor spider, is the basis upon which this exceptional generator is built. Most other details of construction are equally striking in their sturdiness and lasting qualities. For instance:

Field poles—built up of steel laminations which are hydraulically riveted together. Large area damper winding joints are silver brazed for permanence.

Field coils for large low-speed machines are edge-wound copper strap, with several coats of baked-on insulating varnish; for higher speed machines, where heat dissipation is less difficult, coils are formed of double cotton covered copper wire wound over heavy rag paper insulating cells on poles.

Stator core is rigidly held by closely spaced stacking studs between the heavy steel end plates. Stator coils are constructed in a long series of operations for positive and lasting insulation.

For the full story write for the Elliott Synchronous Generator Bulletin PB-2000.

Q-1139

COMPANY

SUPERCHARGER DEPT., JEANNETTE, PA.
ELECTRIC POWER DEPT., RIDGWAY, PA.
Plants at: JEANNETTE, PA. • RIDGWAY, PA.
SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

STEAM TURBINES • GAS TURBINES • GENERATORS • MOTORS • CONDENSERS
FEEDWATER HEATERS AND DEAERATORS • STEAM JET EJECTORS
CENTRIFUGAL BLOWERS • TURBOCHARGERS FOR DIESEL ENGINES
TUBE CLEANERS • STRAINERS • EXPANDERS • FILTERS

DIAMOND

Simplicity

IN YOUR SOOT BLOWERS MEANS

More Dependable Operation

Lower Maintenance Costs

SIMPLICITY... not for its own sake but because it results in improved and more dependable operation . . . and in substantially reduced maintenance costs.

SIMPLICITY has always been a major consideration in the design and development of all types of Diamond Soot Blowers . . . whether permanently installed or retracting . . . whether steam or air is the cleaning medium . . . whether manual or automatic operation.

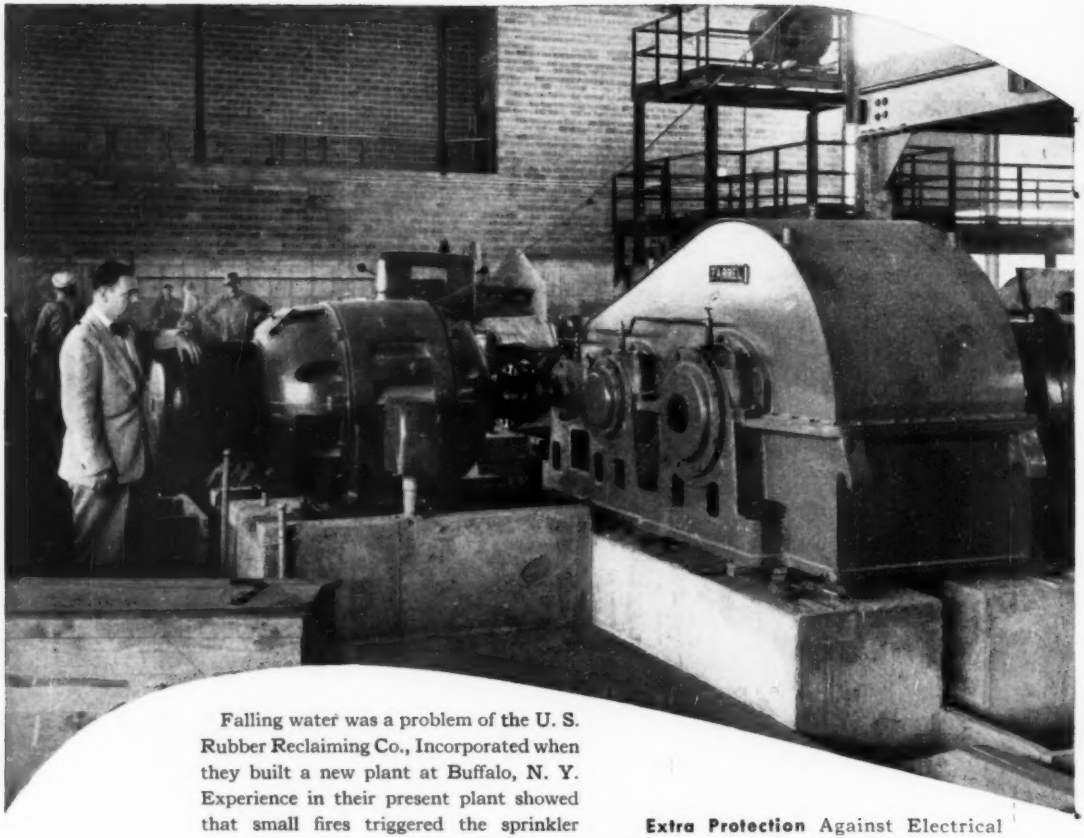
An example of this Diamond Simplicity is in the design and operation of the short retracting soot blower shown below. Many of the parts are interchangeable with the popular Diamond G9B Soot Blower. Instead of using one air motor for projecting and retracting the nozzle and another for rotation while blowing, only a single air motor is used for all operations. The same practice of using a single motor for both retraction and rotation is followed on the long retracting blowers.

Simplicity is one of the important reasons why Diamond Soot Blowers are so generally preferred by engineers responsible for the selection of equipment for central stations—where requirements are most severe. Ask for a copy of Catalog 1014 to see the many other reasons.

DIAMOND
Short Retracting Blower
(MODEL IS)

For cleaning furnace walls or boiler heating surfaces where gas temperatures exceed limit for permanently installed units. Positive poppet type valve prevents leakage and flow until nozzle is in blowing position . . . minimizing possibility of cutting wall box, nozzle and water wall tubes. The 12 inch travel removes nozzle far enough from furnace heat to eliminate air cooling. Lubrication unnecessary. Compact and few working parts. Widely spread bearing surfaces and easily accessible packing. Adjustable pressure control. Uses either air or steam as cleaning medium. Air, electric or manual operation.

DIAMOND POWER SPECIALTY CORP.
DETROIT 31, MICHIGAN
DIAMOND SPECIALTY LIMITED—Windsor, Ontario



Falling water was a problem of the U. S. Rubber Reclaiming Co., Incorporated when they built a new plant at Buffalo, N. Y. Experience in their present plant showed that small fires triggered the sprinkler system and made motors inoperative. In planning the new plant, the need for motors shielded against falling water was recognized. Also, insurance officials required greater motor protection in the new plant—a need that was filled by Tri-Clad high-speed synchronous motors. Now, no production time is lost because of water in motors.

Dripproof construction with no direct openings above the centerline excludes falling water, dirt, and falling objects. Besides this, there are three extra protections that make Tri-Clad synchronous motors last longer.

Extra Protection Against Physical Damage—sturdy, rigid frames and end shields for protection against corrosion, accidental blows, and falling objects.

Extra Protection Against Electrical Breakdown—proved synthetic bonding and insulating compounds protect coils from heat aging, moisture, mild acids and alkalies. Insure longer life.

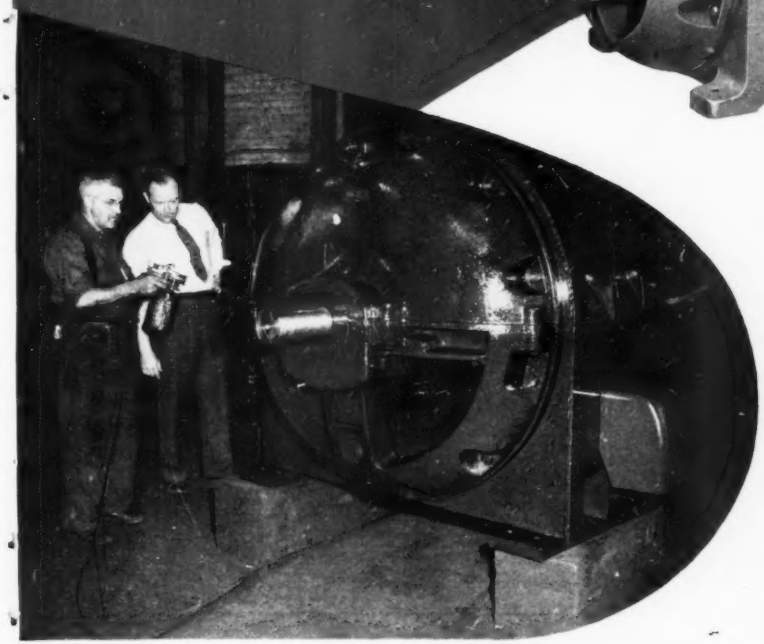
Extra Protection Against Operating Wear and Tear—redesigned bearings and bearing housings insure a permanent supply of cool, clean oil from sealed reservoirs.

Delivery on Tri-Clad high-speed synchronous motors and generators is good. Motors are available in ratings from 20 to 1500 hp at 1800 rpm speeds with proportionate hp ratings at speeds through 514 rpm. Generators from $1\frac{1}{4}$ to 1250 kva. For application engineering and delivery data, call your nearest G-E sales representative today. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

Can a "Sprinkle" Stop Your Plant?

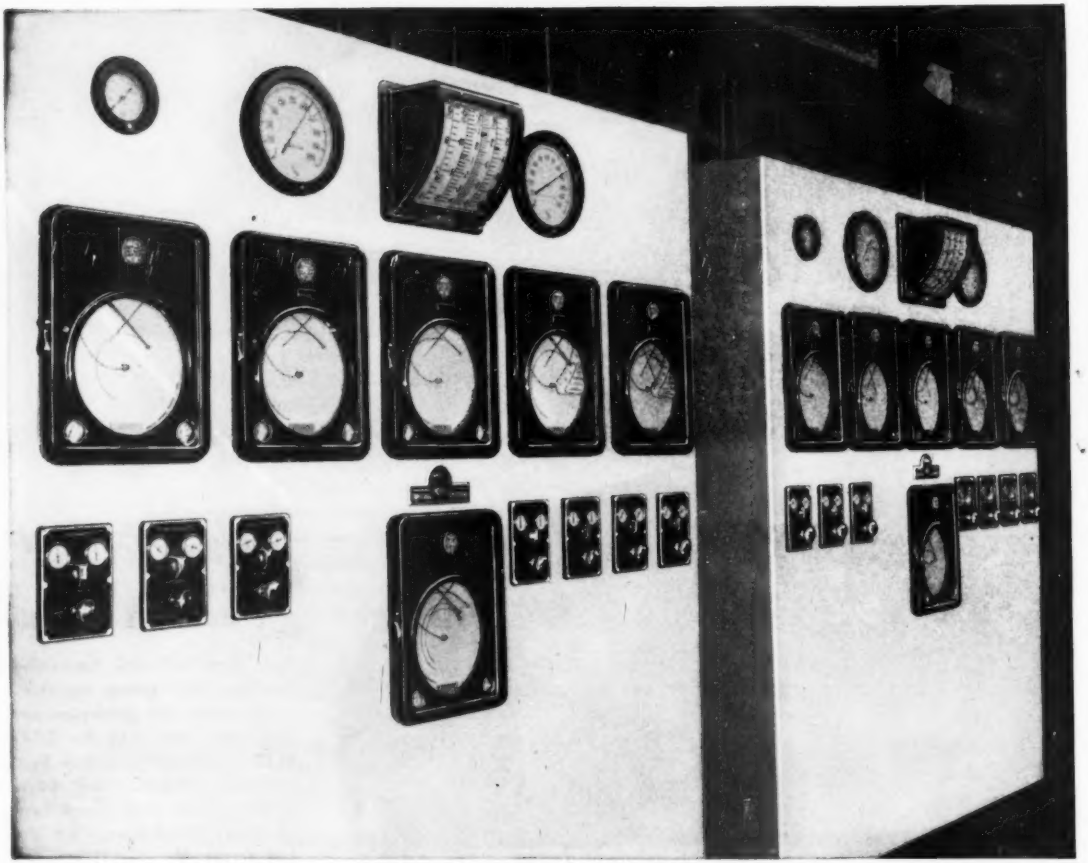
Tri-Clad synchronous motors and generators stay on the job when water falls.



2 *Write today!* DESCRIPTIVE BULLETINS

Two new bulletins describing Tri-Clad high-speed synchronous motors and generators are available now. Ask for GEA-5113, Tri-Clad High-Speed Synchronous Motors, and GEA-5125, Tri-Clad High-Speed Synchronous Generators. Get the full story on the protection value of this new line of motors and generators.

some Btu's are always



Btu's receive no vacations from this co-ordinated Bailey boiler control system on a 135,000 lb. per hr. capacity gas and oil-fired boiler. Controls for combustion, feed water, steam temperature and flue gas temperature are included on this panel.

Branches in: Boston, New York, Schenectady, Philadelphia, Buffalo, Pittsburgh, Charlotte, Cleveland, Detroit, Cincinnati, Atlanta,

on vacation

Yes, some Btu's are always on vacation. Your problem is to prevent too many from getting the habit. Loafing Btu's produce no power. You have to make them work. Then you get low power costs. And that is what you get when you install the Bailey co-ordinated boiler control system.

The Bailey system reduces fuel consumption per pound of steam generated. Combustion, feed water, steam temperature, heater levels, pump speeds and other factors are co-ordinated. Safety of operation is increased—continuity of service is improved. You convert the maximum number of Btu's into power and get all the efficiency your boiler was designed to deliver.

One thing to remember. The Bailey system is not delivered as a standard package. Each one is designed and engineered to the specific job on which it is to be used. That's why it functions so efficiently.

If you are looking for low cost power, it will pay you to call our nearest office.

A-106-2

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO

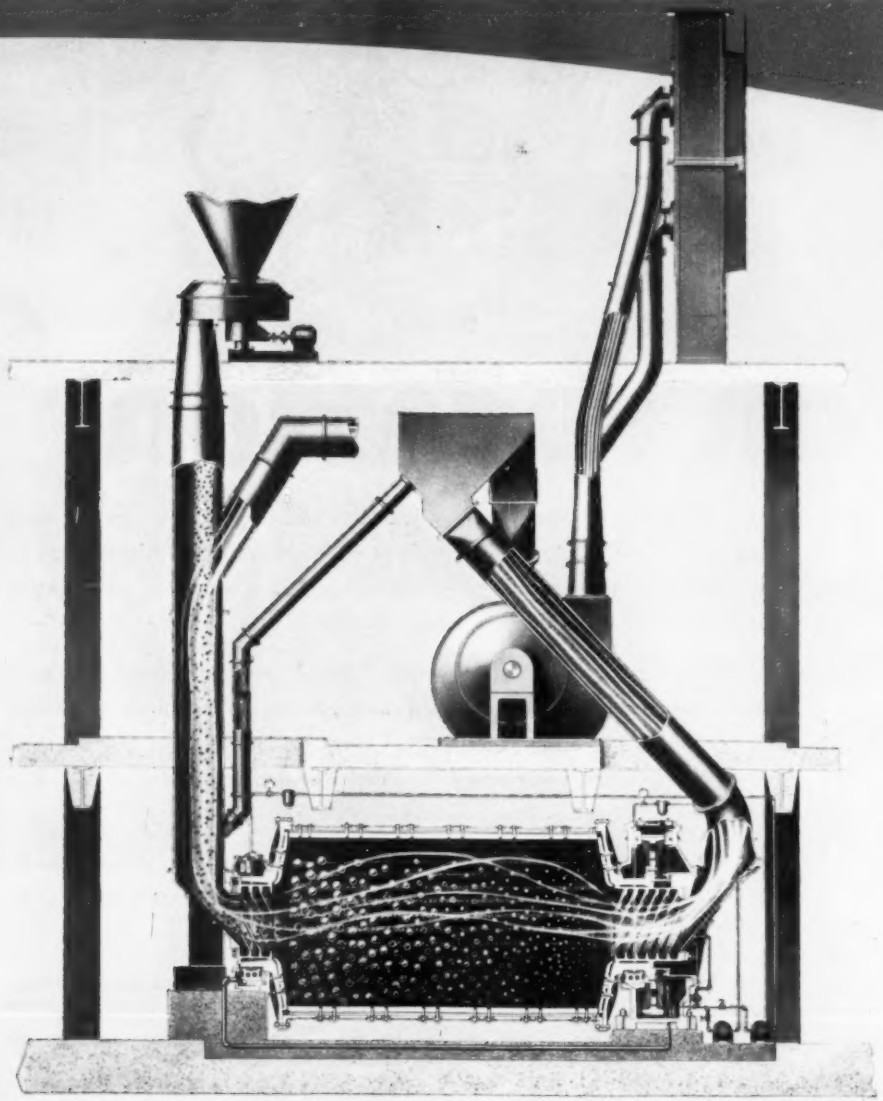
BAILEY METER COMPANY LIMITED, MONTREAL, CANADA

Controls for Steam Plants

COMBUSTION • FEED WATER • TEMPERATURE
PRESSURE • LIQUID LEVEL • FEED PUMPS

Chicago, Milwaukee, St. Louis, New Orleans, St. Paul, Kansas City, Houston, Denver, Los Angeles, Seattle, San Francisco

SAVE ON YOUR FUEL BILL WITH



KVS Pulverized Coal Firing

. . . 'Talcum powder' fineness of pulverizing achieves complete and rapid combustion.

. . . fluctuating loads do not add to your coal bill.

. . . no coal is lost due to banking of fires.

. . . availability is close to 100%.

. . . Coal unsuitable for other types of firing can be utilized to advantage in KVS Air Swept Tube Mills.

These and other economies demonstrated and proved in actual service, result in lower steam costs with KVS Coal Firing.

ENGINEERING SERVICE KVS

Our engineers will furnish complete boiler designs for your steam requirements. Let us help you reduce your operating and fuel costs with KVS pulverized coal firing and KVS steam generators.

Ask for a copy of 97-page Engineering Bulletin No. 44-B containing valuable information on preparation of pulverized fuel and steam generating plants.

Kennedy Products — Kennedy-Van Saun Manufacturing and Engineering Corporation

2 PARK AVENUE • NEW YORK 16, N. Y.

FACTORIES: DANVILLE, PA.

CANADA • ENGLAND • FRANCE • AUSTRALIA

Turbine lubrication costs

CASE STUDY

Annual Savings in Turbine Lubricating Costs with Nonpareil Turbine Oil in a Midwest utility.

Turbine ..... 35,000 KW, 1800 RPM
Oil System Capacity .... 2800 gallons
Operation ... 1931 to 1937 on Turbine Oil X at 45¢ per gallon
Operation ... 1938 to 1948 on Nonpareil Turbine Oil at 87¢ per gallon
Annual Cost of Lubrication with Turbine Oil X ..... $ 911.57 *
Annual Cost of Lubrication with Nonpareil Turbine Oil .... $ 284.13 *
Annual Saving 68.8%

CASE STUDY

Annual Savings in Turbine Lubricating Costs with Nonpareil Turbine Oil on a large utility turbine.

Turbine ..... 80,000 KW, 1800 RPM
Oil System Capacity .... 8,000 gallons
Operation ... Dec. 1935, to April 1942, on Turbine Oil Y at 39¢ per gallon
Operation ... May 1942 to Jan. 1948 on Nonpareil Turbine Oil at 88¢ per gallon
Annual Cost of Turbine Lubrication with Turbine Oil Y ..... $ 575.30 *
Annual Cost of Lubrication with Nonpareil Turbine Oil ..... $ 503.93 *
Annual Saving 12.4%

STANDARD OIL COMPANY (INDIANA)

CUT...up to 68%

NONPAREIL Turbine Oil

"Will outlast your turbine"

STUDIES have been made of typical utility company operations to determine how much the *price* of turbine oil affects the *cost* of turbine operation. Three such studies are summarized here. In each case, the price of the original fill of oil was 38% to 55% *less* than that for Nonpareil. But in each case the total annual cost for lubrication, when all factors are considered, show a saving with Nonpareil.

You can find out how much Nonpareil will save on your lubricating costs. Standard Oil Lubrication Engineers have facts and figures to help you determine what would be your costs with Nonpareil for comparison with your present costs.

Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, to secure the services of the Engineer nearest you.

CASE STUDY

Annual Savings in Turbine Lubricating Costs with Nonpareil Turbine Oil in a Midwest utility system.

Turbine ..... 20,000 KW (Now 30 years old)

Oil System Capacity .... 550 gallons

Operation ... June 1940, to Aug. 1944, on Turbine Oil Z at 55¢ per gallon

Operation ... Oct. 1944 to Oct. 1948 on Nonpareil Turbine Oil at 89½¢ per gallon

Annual Cost of Lubrication with Turbine Oil Z ..... $ 83.90

Annual Cost of Lubrication with Nonpareil Turbine Oil ..... $ 69.49 *

Annual Saving 17.2%

*Includes (1) cost of original fill, (2) oil replacements, (3) oil treating or sweetening, (4) cleaning turbine oil systems, (5) filter maintenance, where these items apply.

STANDARD OIL COMPANY (INDIANA) STANDARD

New Tube-Type Fan-Cooled

THE NEW ALLIS-CHALMERS tube-type totally-enclosed fan-cooled motor reduces maintenance to a point never before reached in totally-enclosed design.

This saving is made possible by the unique method of cooling. Straight tubes, running parallel to the shaft, surround the stator core. Internal fans circulate air within the motor to transfer heat to the tubes. An external fan moves outside air through the tubes to remove heat quickly and effectively. This heat exchanger is so efficient that the new Allis-Chalmers tube-type motor is only slightly larger than an open motor of the same rating.

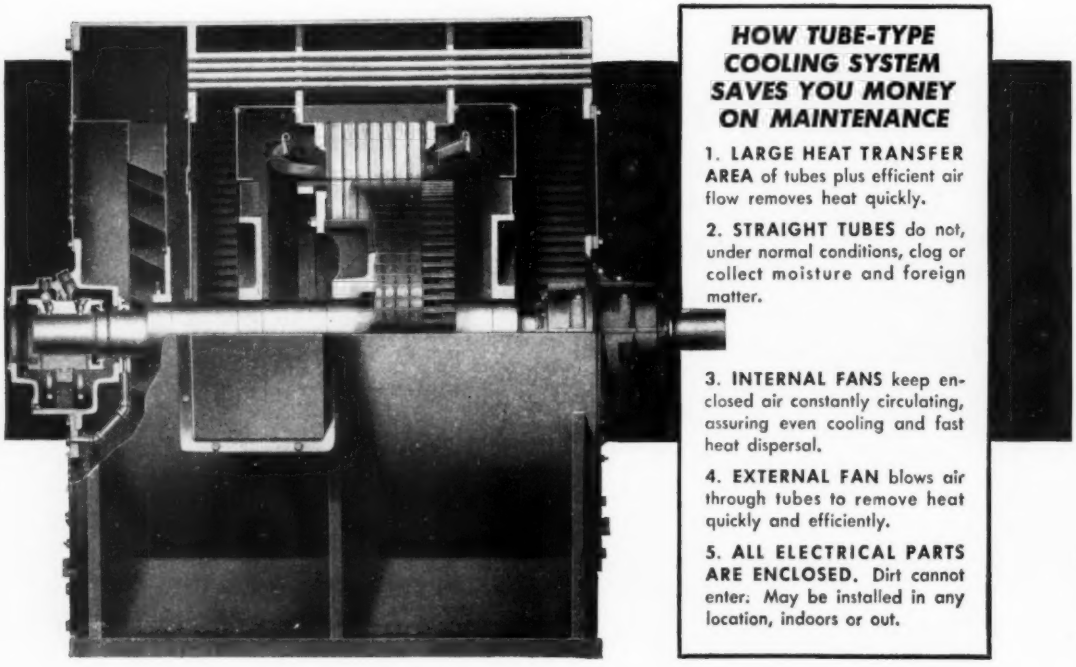
MAINTENANCE MATERIALLY REDUCED

The new Allis-Chalmers tube-type motor is practically self-cleaning because the tubes are straight, the air passages unrestricted, and the cooling air flows at sufficient speed to carry foreign matter out with it. Should unusually dirty air conditions make cleaning desirable, tubes can be swabbed out quickly and easily. Since all electrical parts are enclosed, this new motor can be installed indoors or out in any atmosphere.

COOLING EFFICIENCY PROVED

Three years of successful operation in the field have proved that the new Allis-Chalmers tube-type, totally-enclosed, fan-cooled motor can bring important savings to any industry faced with high motor maintenance costs due to dirty, corrosive or hazardous operating conditions. For information on this new motor contact your nearest A-C district office or write for bulletins 05B7150 and 51R7149.

ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE, WIS.



HOW TUBE-TYPE COOLING SYSTEM SAVES YOU MONEY ON MAINTENANCE

1. **LARGE HEAT TRANSFER AREA** of tubes plus efficient air flow removes heat quickly.

2. **STRAIGHT TUBES** do not, under normal conditions, clog or collect moisture and foreign matter.

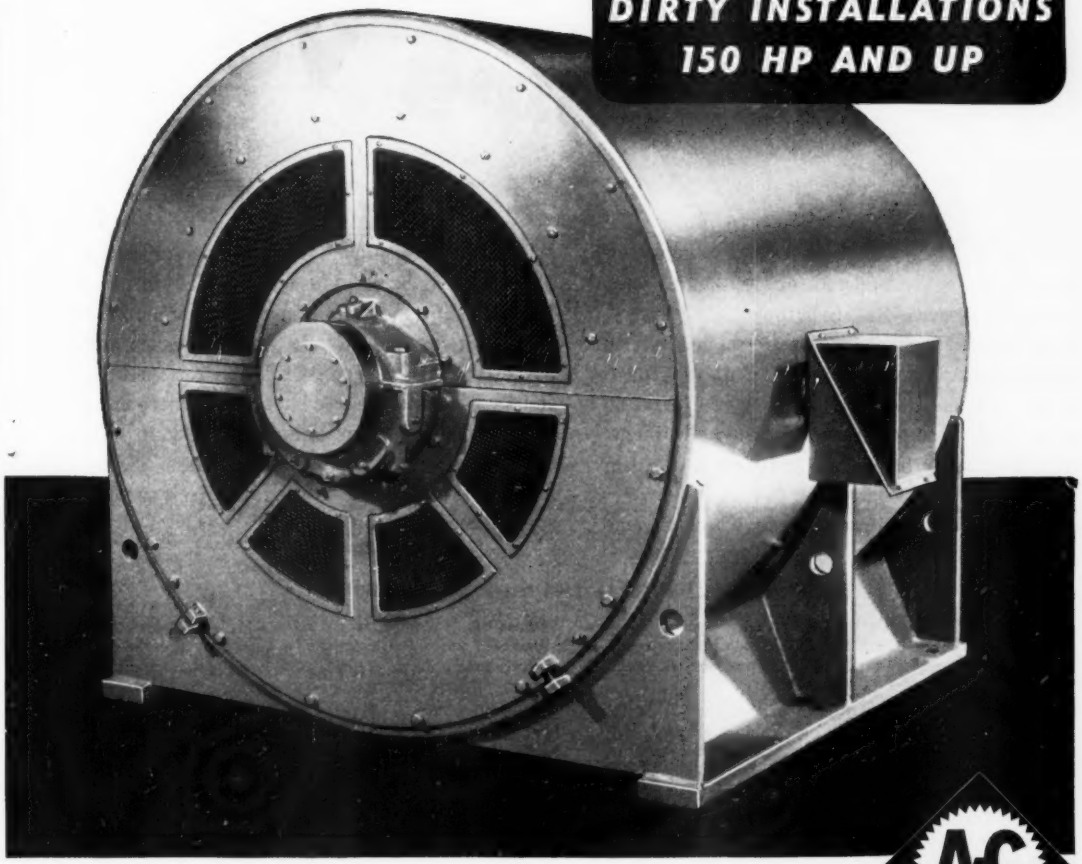
3. **INTERNAL FANS** keep enclosed air constantly circulating, assuring even cooling and fast heat dispersal.

4. **EXTERNAL FAN** blows air through tubes to remove heat quickly and efficiently.

5. **ALL ELECTRICAL PARTS ARE ENCLOSED.** Dirt cannot enter. May be installed in any location, indoors or out.

Totally-Enclosed Motors!

MAINTENANCE CUT SHARPLY ON OUTDOOR, CORROSIVE AND DIRTY INSTALLATIONS 150 HP AND UP



A-C ALLIS-CHALMERS

ALLIS-CHALMERS

A 2643

Pioneers in Power and Electrical Equipment From Generation Through Utilization

In YOUR industry there's a plant with your problems now using VU

You may feel that your steam generating requirements are unusual, or peculiar to your industry. Perhaps you are in the textile industry, a paper plant, a mine, or a brewery. You may be generating steam with pulverized coal for a utility station . . . or even burning crushed cane to produce process steam for a sugar refinery. Your needs may be as little as 10,000 lb of steam per hr, or exceed 300,000.

Yet, paralleling your problems, there is some similar plant profiting from VU performance. For, in every basic industry, the VU Unit has met the supreme test of use. Throughout the United States and Canada, Latin America and abroad, the VU has been selected for installations with an aggregate capacity of more than 80,000,000 lb of steam per hr. Spot check, in your own industry, the experience of others . . . see how the versatile VU Unit adapts itself to your *special* needs. B239

DOESN'T THIS DESCRIBE THE UNIT YOU WANT?

Adaptable – The VU Unit is adaptable to limited space conditions, to the use of any fuel or method of firing, and to widely varying requirements of load, pressure and temperature.

Efficient – The VU Unit operates at efficiencies up to 88 per cent, due to a basic design which combines efficient combustion, maximum exposure of evaporative surface to radiant heat, cross-travel of gases in tube banks, and concentration of large heating surface in the last bank.

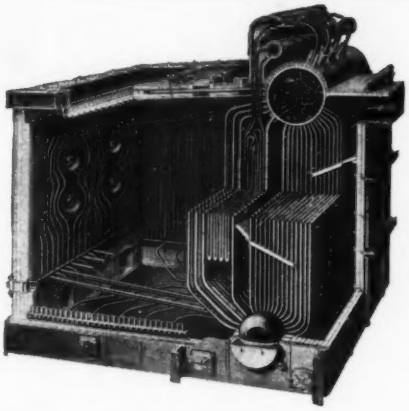
Flexible – The VU Unit may be operated over a wide range of output, is responsive to extreme fluctuation in load, and is well adapted to automatic combustion control.

Symmetrical – Symmetrical design of longitudinal sections eliminates lazy tubes, since each section has the same furnace volume, same evaporative surface, same amount of water, and produces the same amount of steam. Moreover, the uniform release of steam along the entire length of the drum eliminates surging water level and periodic carry-over of water slugs.

Standardized – Details, as well as general design, are standardized – a safeguard against errors or oversights in manufacture and installation. And the economies of standardized design are reflected in first cost, since much of the engineering of individual units is avoided.

COMBUSTION ENGINEERING

A MERGER OF COMBUSTION ENGINEERING COMPANY, INC. AND THE SUPERHEATER COMPANY

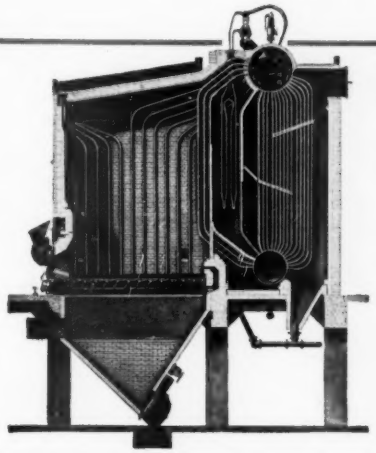


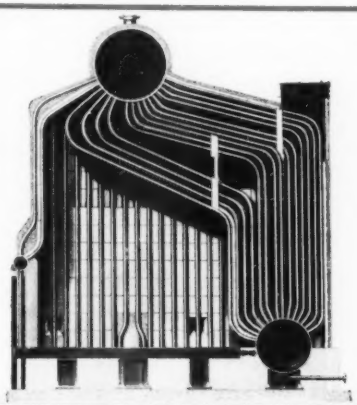
Type VU Steam Generator
(for the higher capacity range)

This unit, the original VU design, may be fired by pulverized coal, oil or gas, or any combination of these fuels. Available for capacities up to 350,000 lb of steam per hr, pressures up to 1000 psi and steam temperatures up to 900 F, or higher. Furnace bottom may be as shown or may be of hopper type. Economizer or air heater surface may be added.

Type VU Steam Generator
(for the middle capacity range)

In this VU design, shown equipped with a C-E Spreader Stoker, the furnace proportions and arrangement of water wall surfaces may be adapted for firing by any type of mechanical stoker. Design is also adaptable for firing by oil or gas. Economizer or air heater surface may be added. Approximate capacity range 25,000 to 100,000, or more, lb per hr.





C-E Package Boiler
(for the lower capacity range)

This youngest member of the VU family is designed for industrial load conditions and particularly for plants having small operating and maintenance forces. Capacities range from about 10,000 to 50,000 lb per hr. Firing may be by spreader stoker, single-retort underfeed stoker, oil or gas burners. Any of these methods may be substituted for any other, should fuel market conditions make this desirable.

—SUPERHEATER, INC.
200 MADISON AVENUE, NEW YORK 16, N. Y.
C-E

HIGHER P

Call For

YARWAY UNIT TANDEMS

Years of service in the high pressure plants of leading Utilities and Industrials have proved the soundness of design and metallurgy of Yarway Unit Tandems.

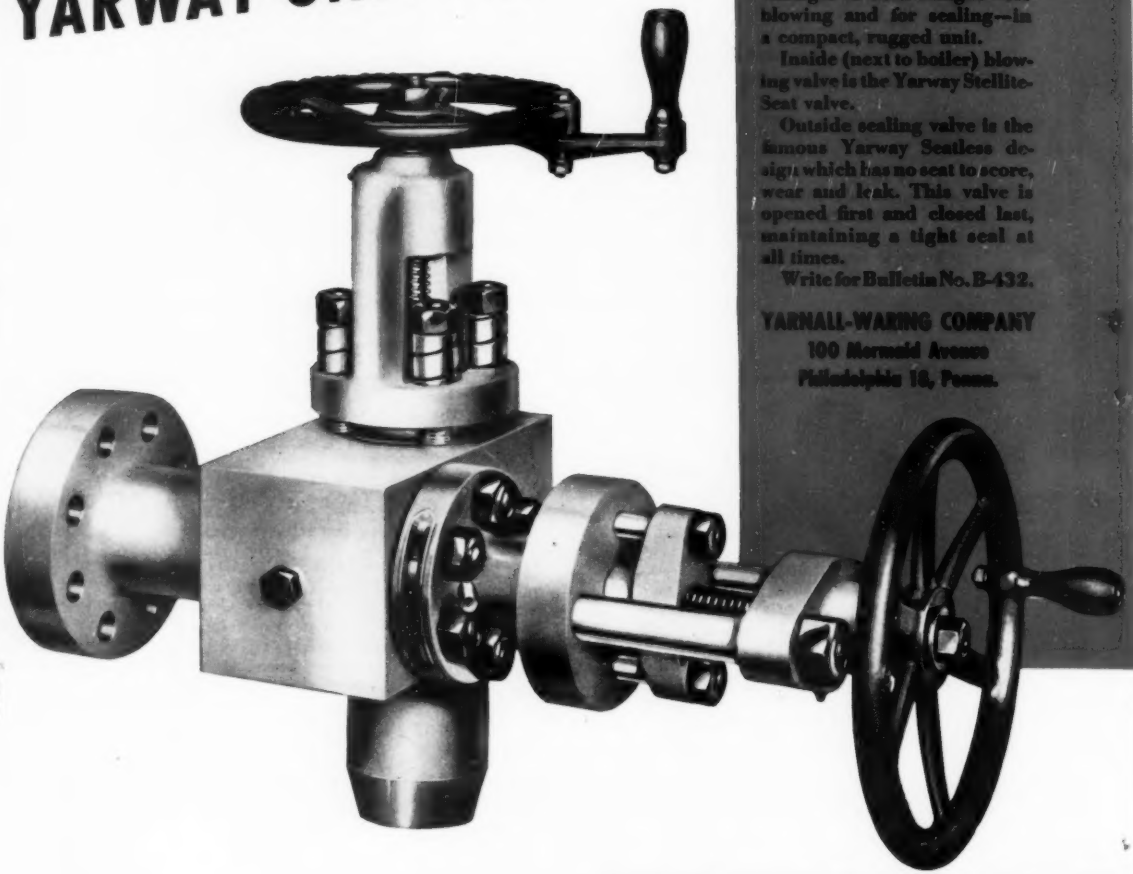
Yarway Unit Tandems are built for pressures up to 2500 psi. Combining a Stellite-Seat and a Seatless valve in a single one-piece forged steel body, this tandem provides the advantages of both designs—for blowing and for sealing—in a compact, rugged unit.

Inside (next to boiler) blowing valve is the Yarway Stellite-Seat valve.

Outside sealing valve is the famous Yarway Seatless design which has no seat to score, wear and leak. This valve is opened first and closed last, maintaining a tight seal at all times.

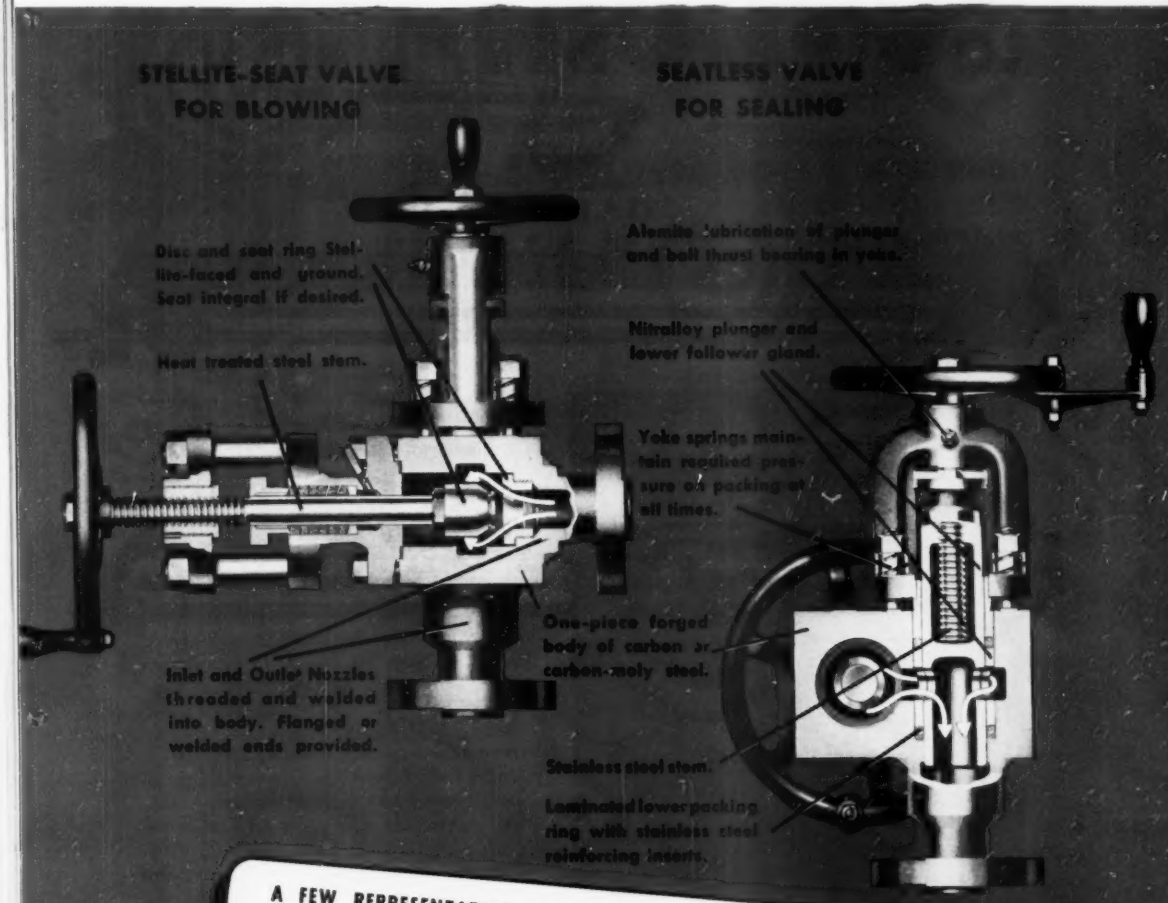
Write for Bulletin No. B-432.

YARNALL-WARING COMPANY
100 Mermaid Avenue
Philadelphia 18, Penna.



YARWAY

RESSURES


STELLITE-SEAT VALVE
FOR BLOWING
SEATLESS VALVE
FOR SEALING
Disc and seat ring Stellite-faced and ground. Seat integral if desired.
Heat treated steel stem.
Inlet and Outlet Nozzles threaded and welded into body. Flanged or welded ends provided.
Alemite lubrication of plunger and ball thrust bearing in yoke.
Nitralloy plunger and lower follower gland.
Yoke springs maintain regulated pressure on packing at all times.
One-piece forged body of carbon or carbon-moly steel.
Stainless steel stem.
Laminated lower packing ring with stainless steel reinforcing inserts.

A FEW REPRESENTATIVE USERS OF HIGH PRESSURE YARWAY BLOW-OFF VALVES

• UTILITIES •

Philadelphia Electric Co.
Boston Edison Co.
Pacific Gas & Electric Co.
Pennsylvania Power & Light Co
Georgia Power Co.
Cleveland Elec. Illuminating Co.
Connecticut Light & Power Co.
Indiana-Michigan Power Co.

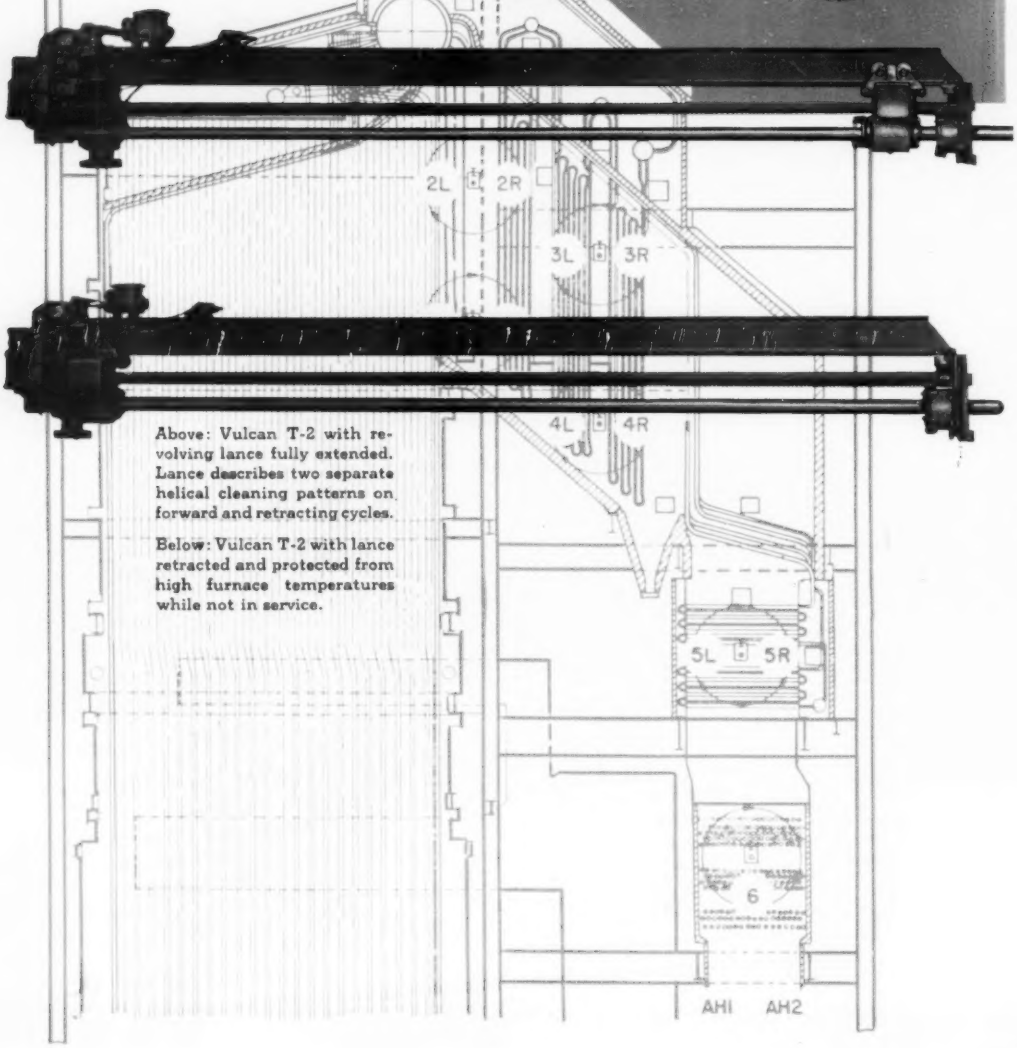
• INDUSTRIAL PLANTS •

Celanese Corp.
R. J. Reynolds Tobacco Co.
Eastman Kodak Co.
Armour & Co.
American Viscose Co.
Lever Bros. Co.
Armstrong Cork Co.
Bethlehem Steel Co.

BLOW-OFF VALVES

SUNBURY

First unit (150,000 kw.) of Pennsylvania Power & Light Co. at Shamokin Dam, Pennsylvania.



Above: Vulcan T-2 with revolving lance fully extended. Lance describes two separate helical cleaning patterns on forward and retracting cycles.

Below: Vulcan T-2 with lance retracted and protected from high furnace temperatures while not in service.

FIRST CENTRAL STATION using only *Long Retractable* SOOT BLOWERS

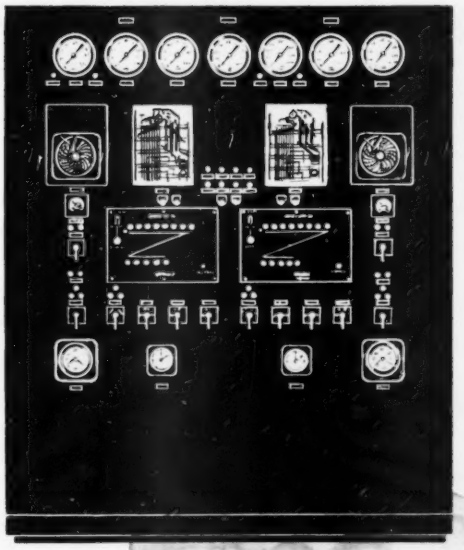
ANOTHER VULCAN FIRST!

44 VULCAN T-2's (11 PER BOILER) ARE PUSH BUTTON OPERATED THRU COMPLETELY AUTOMATIC SEQUENTIAL CONTROL

Vulcan T-2 Long Retractable Soot Blowers were selected for this important Central Station because of their great cleaning range and rugged construction; their many safety devices; and their low maintenance.

These compact units feature dual motors; ball or roller bearings thruout; enclosed gears sealed in oil; push button controls at the units as well as remote; and they may be installed at any angle or inverted. Over 600 have been ordered.

At Sunbury the operator may push a single button at the Control Panel and automatically in proper sequence, one following the other—all 11 T-2 units, or fewer as selected, of a given boiler will complete their cleaning cycle and return to their protected "out" position. The operator may also extend or retract any single T-2 at will by means of its individual control button. Write for bulletin 474.



Two Vulcan Panels as above provide full automatic sequential operation of 44 Vulcan T-2 Retractable Soot Blowers serving the 4 boilers.

VULCAN SOOT BLOWER CORP.
DUBOIS, PA.

VULCAN
STEAM OR AIR

SOOT BLOWERS

DIVISION OF CONTINENTAL FOUNDRY & MACHINE CO.

FLUOR

Counterflo cooling towers

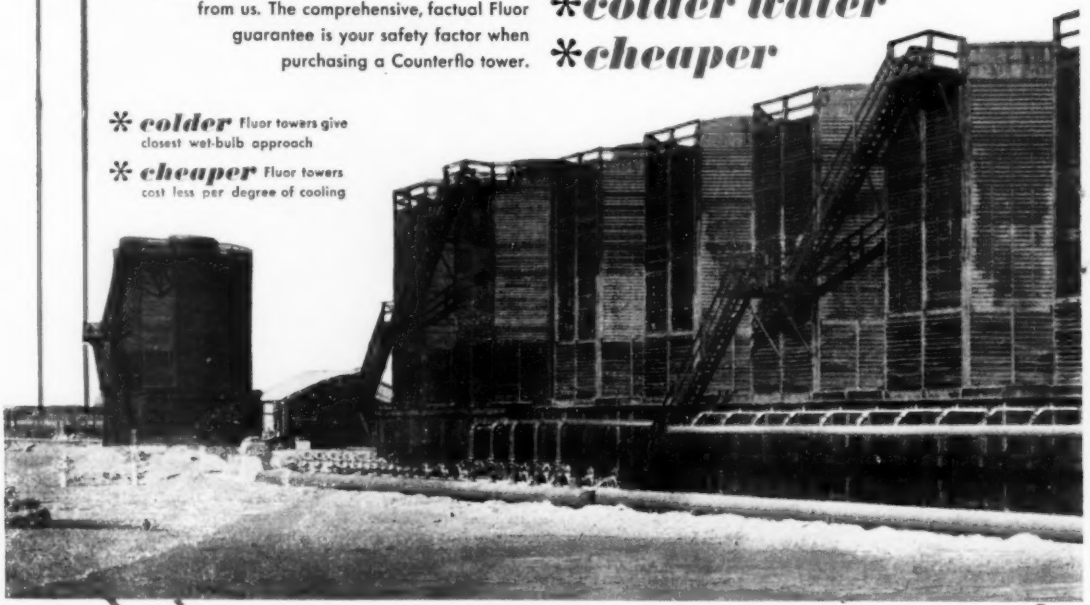
every one guaranteed to give you
****colder water***
****cheaper***

Guaranteed Performance is more than a phrase with Fluor. We encourage you to test your Counterflo tower. We know—and we want you also to be sure—that you receive the full measure of cooling performance you originally specified—for the price originally stated.

We would like to quote on your new tower. Please do not add a "safety factor" to your requirements when requesting a quotation from us. The comprehensive, factual Fluor guarantee is your safety factor when purchasing a Counterflo tower.

* ***colder*** Fluor towers give closest wet-bulb approach

* ***cheaper*** Fluor towers cost less per degree of cooling



New methods of mass manufacture, using prefabricated parts, have been developed by Fluor to lower costs even on such large units as this. This Counterflo tower group has ten coilshed induced-draft cells. It cools gas, lube oil, and jacket water for a main-line natural-gas compressor station. Total capacity is 10,520 gpm. ***Guarantee:*** *6335 gpm cooling from 103.6° to 82° at 74° wet bulb (largest cell group only).* ***Performance:*** *all units as guaranteed.*

FLUOR

THE FLUOR CORPORATION, LTD.

Los Angeles 22 • HOUSTON • BOSTON
SAN FRANCISCO • TULSA • KANSAS CITY
NEW YORK • PITTSBURGH

BE SURE WITH FLUOR

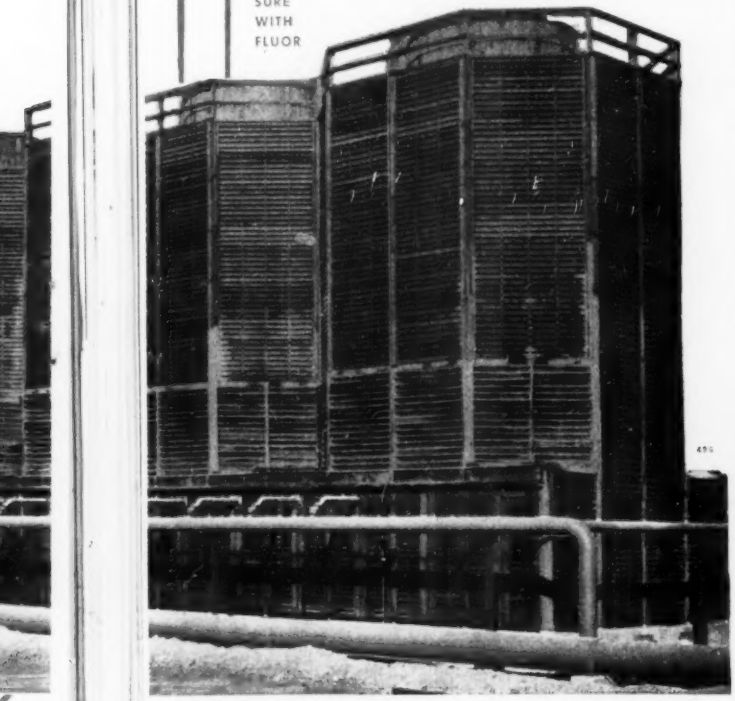
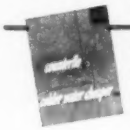


photo by Elwood M. Payne



SAVE YOUR COMPANY MONEY

Before buying a cooling tower, we urge you to look at the engineering facts presented in the new booklet "Colder Water Cheaper." Write us for your copy.

Aerator Towers

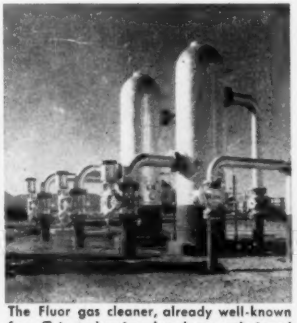
Fluor Aerator cooling towers have distinctive economy features and are most practical in certain cooling applications.

Fin-Fan Units

Fluor air-cooled heat exchangers are more economical where make-up water is expensive, where water has bad scaling characteristics, and where the temperature of fluid to be cooled is relatively high. (Manufactured and sold by Fluor and Griscom-Russell Co.)

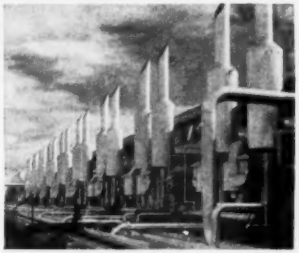
Pulsation Dampeners

Fluor pulsation dampeners remove destructive vibrations and instrument irregularities caused by pulsative gas flow.



Gas Cleaners

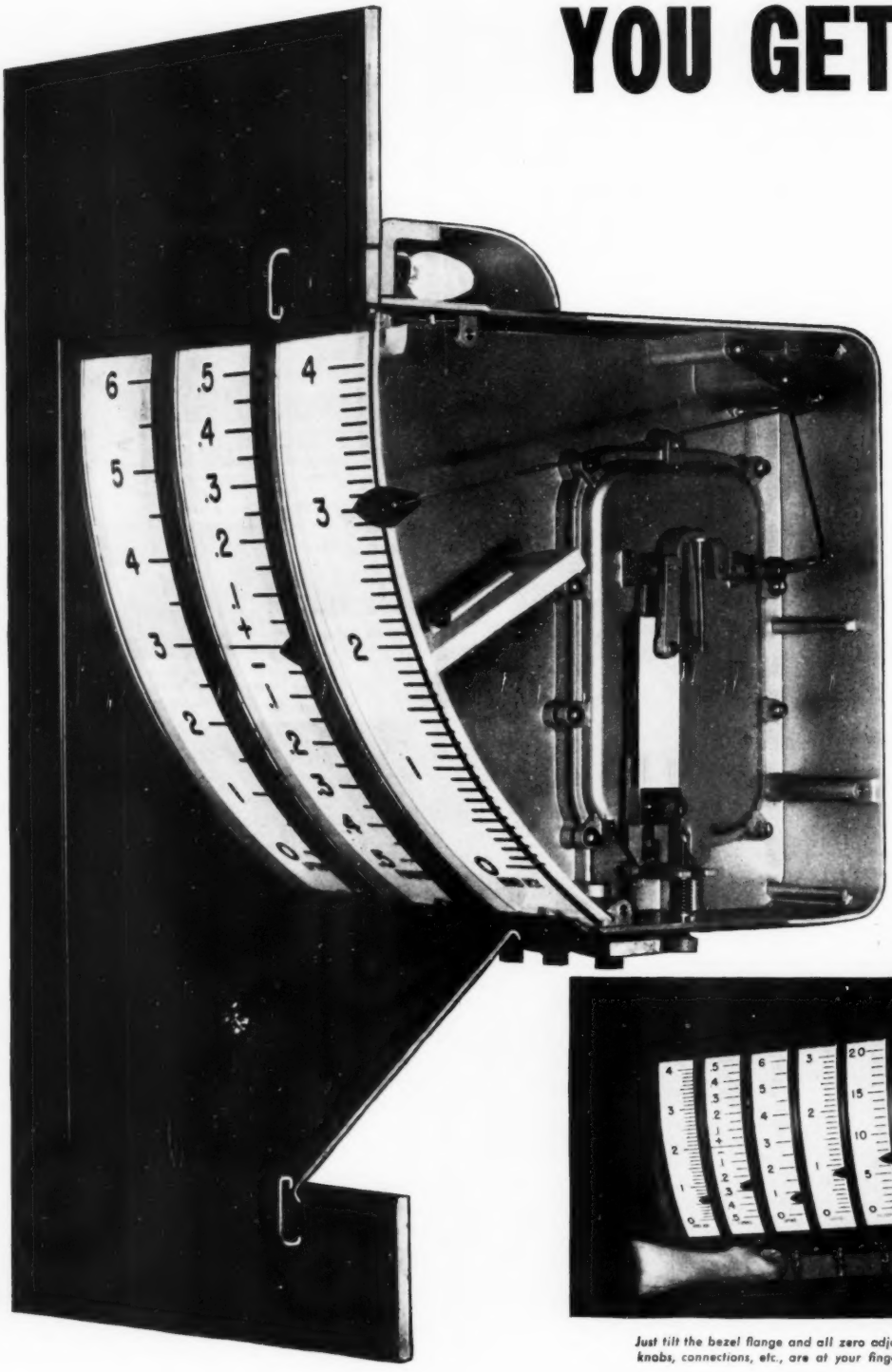
The Fluor gas cleaner, already well-known for efficient cleaning, has been redesigned to give still better performance.

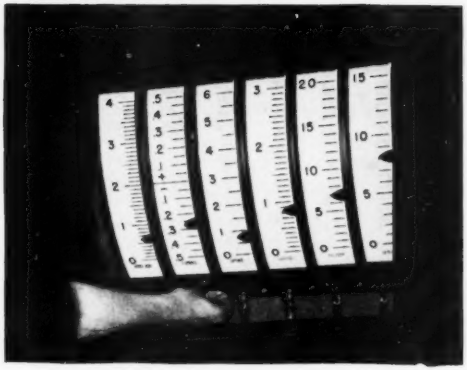


Mufflers

Fluor mufflers, redesigned to incorporate pulsation-dampener principles, reduce exhaust-line noises to less than the mechanical noises of the compressor room.

YOU GET





Just tilt the bezel flange and all zero adjustment knobs, connections, etc., are at your finger tips.

ALL OF THESE FEATURES

In The Republic Multi-Point Draft and Pressure Gage

1. EASY TO OPERATE: All adjustments can be made from the front of the gage regardless of whether it be flush or projected mounted. On the flush mounted gage a bezel flange, which tilts back, conceals the zero adjusting knobs, pipe connections, mounting bolts, etc.

2. INDIVIDUAL UNITS: Each draft or pressure element is individually housed in a die cast case forming a complete compact unit.

3. UNITS EASILY REMOVED: The individual units can be removed from the front of the gage as you would remove a book from a shelf. This can be easily and quickly done without interfering with the operation of any other unit.

4. EASY TO MAINTAIN: Because each element is a complete unit in itself which can be easily removed, maintenance is greatly simplified.

5. INDIVIDUAL ILLUMINATION: Each scale is individually illuminated from the back by a light located outside of the element housing.

6. UNIFORM SIZE: All units are of one standard size which permits new units to be added or interchanged as required.

7. ALL STANDARD RANGES: Elements are supplied for all standard ranges of draft, pressure or differential.

8. SENSITIVE DIAPHRAGM: All elements, except those for high pressures, are actuated by an extremely sensitive bellows type of diaphragm.

9. MULTIPLE UNITS: Any number of units of draft, pressure or differential may be combined in one multi-point gage which is supplied for either flush or projected mounting.

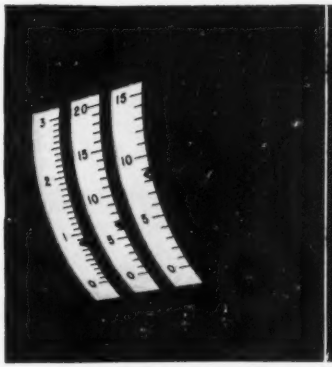
10. FLOW, CO_2, TEMPERATURE: Developed primarily to indicate drafts, pressures and differentials, the Republic multi-point gage can also be made to indicate other quantities such as flow, CO_2, temperature, liquid level, etc. In each case the corresponding standard Republic instrument is used.

The sectional view shown on the opposite page illustrates the extreme simplicity and compactness of the Republic Multi-Point Draft and Pressure Gage. Every detail has been designed to assure ease of maintenance and continuous operation as well as accuracy and sensitivity.

Write for a copy of Bulletin No. 802

REPUBLIC FLOW METERS CO.

2240 DIVERSEY PKWY. **CHICAGO 47, ILLINOIS**

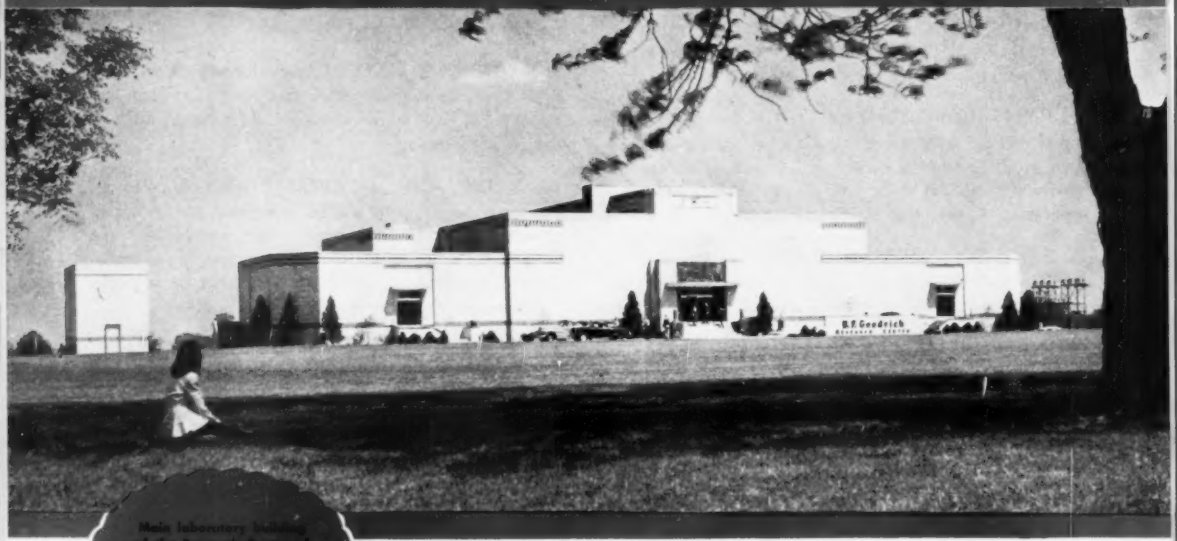


Supplied for either flush or projected mounting.

Any unit can be easily removed from the front without disturbing any other unit.

Each element is a complete, compact, sealed unit.

Air of



Main laboratory building of the Research Center of The B. F. Goodrich Company near Brecksville, Ohio, about midway between Akron and Cleveland

● The huge new B. F. Goodrich Research Center at Brecksville, Ohio, is engaged in basic studies leading to products for "easier, safer and more economical living", a project in which B. F. Goodrich has already become distinguished by a long list of "firsts".

To properly ventilate this up-to-date research laboratory, B. F. Goodrich bought more than 160 Buffalo Fans, which are now giving quiet, efficient service.

In shops, office buildings, stores or amusement places, it pays to get the benefits of "Buffalo" engineering and heavy-duty construction in fan and air conditioning work. Remember, fine performance, long life and good efficiency have combined for many years to give Buffalo equipment the air of distinction which it provides on so many outstanding installations.

Buffalo Sales Representatives, experienced air engineers, are anxious to work with you in the selection of suitable air-handling and air-conditioning equipment.

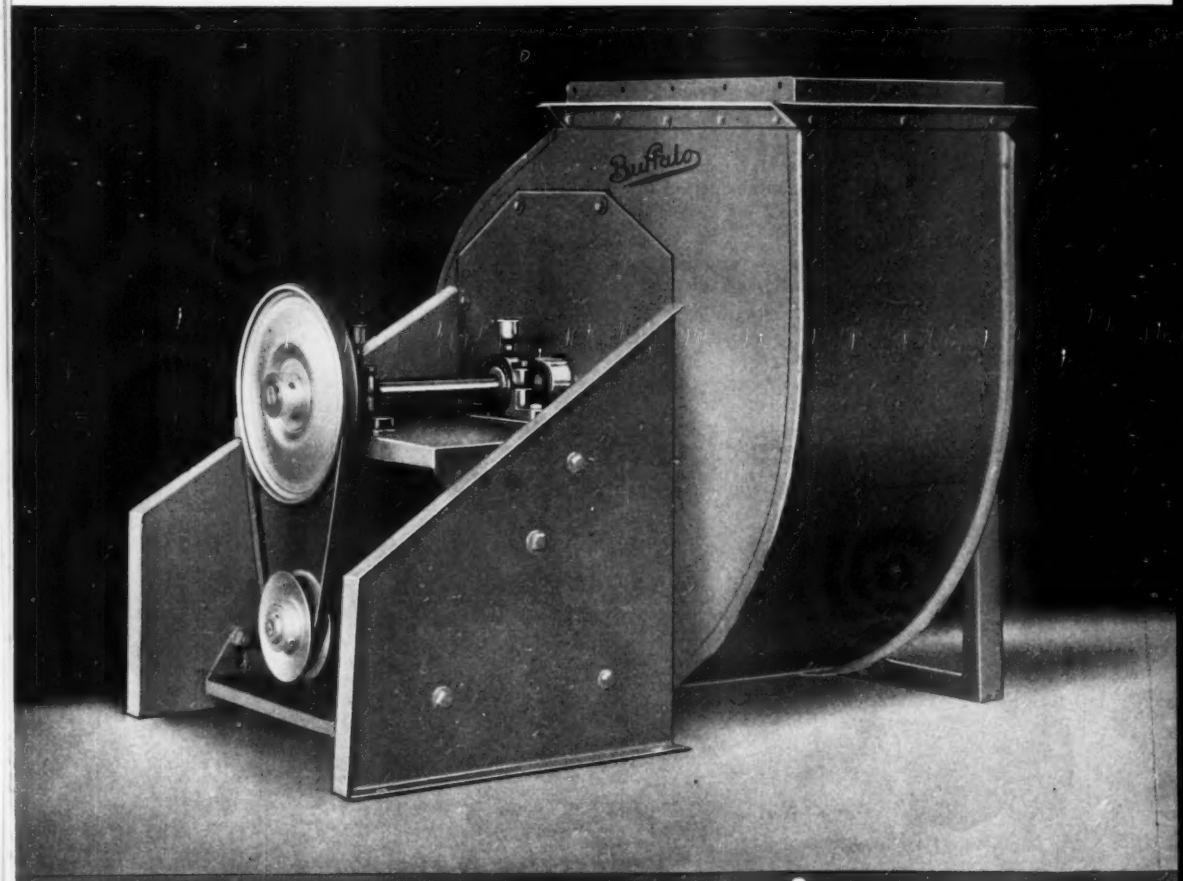
BUFFALO FORGE COMPANY

488 BROADWAY BUFFALO, NEW YORK

● Canadian Blower & Forge Co., Ltd., Kitchener, Ont., Branch Offices in all Principal Cities

Distinction

"A distinguishing quality or mark"—*Webster*



AIR: Literal Meaning—The invisible, odorless and tasteless mixture of gases which surrounds the earth.

Figuratively—The peculiar look, appearance or bearing of a person, peculiar to, or expressive of some personal quality or emotion.—Webster.

"Buffalo"

FIRST FOR FANS

Safeguard your Production Goal with POWELL VALVES

Probably the chief reason why American Industry leads the world in productivity is the practice of setting up production goals—and then achieving them.

Naturally the achievement depends, to a large extent, on the human element; but in this technological age the efficiency of equipment—and especially flow control equipment—plays a major part.

That's why Powell builds a line of valves to meet the specific requirements of every known industrial flow control service. Furthermore, in every valve, long life and dependability have been emphasized.

So, no matter what your flow control problems may be, Powell has the answers. Write for full information on applications of Powell Valves.

Fig. 1793—125-pound Iron Body Bronze Mounted Gate Valve. Made in sizes 2" to 30", incl. Has outside screw rising stem, bolted flanged yoke and taper wedge solid disc. Taper wedge double discs can be provided in sizes 2" to 12", incl.

Fig. 11331-Y—Class 1500-pound, new Powell design, Cast Steel "Y" Valve with welding ends and patented Pressure Sealed Bonnet. This design permits almost unobstructed flow through the valve body, practically eliminating all pressure drop and turbulence.

POWELL

Fig. 11365—Class 1500-pound Cast Steel Horizontal Life Check Valve with welding ends, Pressure Sealed Cap and piston-guided disc. Streamline design permits maximum flow through the valve with minimum pressure drop.

Fig. 11303—Class 1500-pound Cast Steel Gate Valve with welding ends and new patented Pressure Sealed Bonnet.

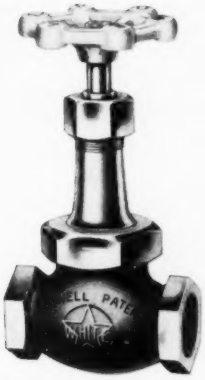


Fig. 1708 — 200-pound Bronze Globe Valve with screwed ends, union bonnet, renewable specially heat treated stainless steel seat and regrindable, renewable wear-resisting "Powellium" nickel-bronze disc.

Fig. 19031—Class 900-pound Cast Steel, Streamlined Pattern, Globe Valve with welding ends and patented Pressure Sealed Bonnet. This improved design reduces pressure drop and turbulence to the minimum. Spur gear operation (shown with gear cover removed).

The new patented Pressure Sealed Bonnet not only eliminates heavy body-bonnet flanges, bolts and nuts, thus making the valve lighter in weight and easier to install, but also assures tighter seal at the body-bonnet joint.

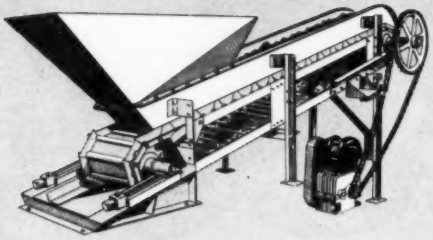
The Wm. Powell Company

Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

VALVES

S-A centrifugal action boat trimmer for loading and trimming bulk materials into holds of ships.



S-A pan conveyor for feeding bulk materials.

Stephens-Adamson Engineers are Qualified to

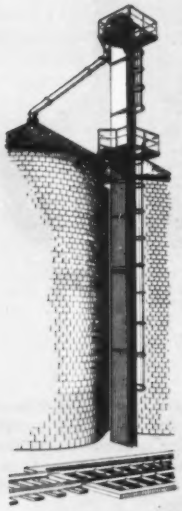
SURVEY Your SYSTEM

for Handling Bulk Materials

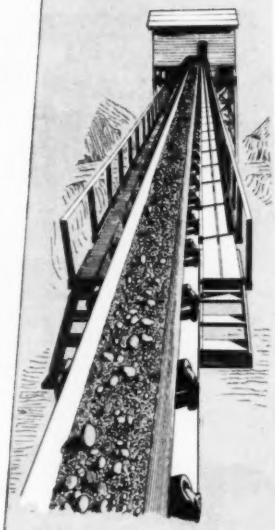
We offer a check-up by our well-qualified staff of specialists in handling bulk materials—from lumps to powder.

The reasons for such a survey are *improvement* of product, and saving in handling cost. The recommendations you receive will be based on 50 years of installing successful conveying systems. Since we make *every* type of conveyor, we can propose without prejudice the best type for your job.

Write us to check whether your present conveyor system is right, or could be materially improved.



S-A bucket elevator storing bulk materials in two silos.



S-A belt conveyor with roller bearing equipped carriers.

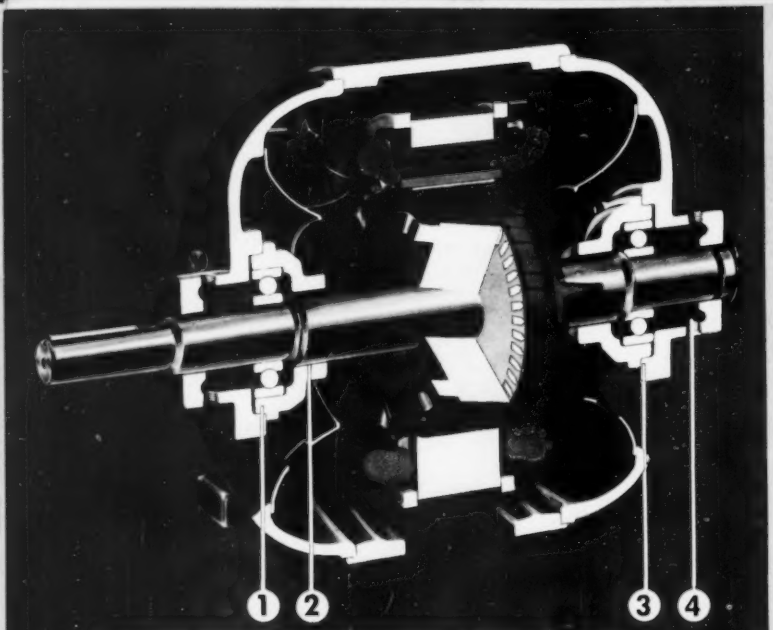
STEPHENS-ADAMSON

5 RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF. • BELLEVILLE, ONT.

Designers and Manufacturers of All Types of

BULK MATERIAL HANDLING EQUIPMENT

YOU CAN'T BEAT A
TRI CLAD MOTOR FOR
EASY MAINTENANCE
GENERAL ELECTRIC
HERE'S
WHY



Notice (1) how Tri-Clad bearings are surrounded by and rigidly supported in solid cast-iron housings. Compare the long, close-running fit between housing and shaft (2) with other motor bearings. Examine the tight rabbet fit between inner cap and end shield (3) which keeps dust and moisture out and lubricant in. See, too, the pressure-relief greasing system (4) that makes it easy to lubricate if you need to.

You can't beat a TRI CLAD motor for easy maintenance

A TRI-CLAD MOTOR will run safely without lubrication for years—for as long as any other general-purpose motor you can buy. The big thing is—it's *grease-gun easy* to lubricate a Tri-Clad if you need to.

You don't have to take a Tri-Clad motor down and disassemble the bearings to lubricate it. You don't have to follow special instructions. A standard gun and a good grease are all you need.

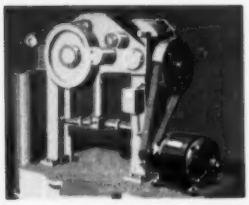
And remember, Tri-Clad gives you all the extra protection that only cast-iron structure can give . . . Extra protection against rust and corrosion . . . Extra protection against mechanical abuse and permanent distortion . . .

Extra protection that has been proved in more than 5 billion hours of rough-and-tumble industrial service.

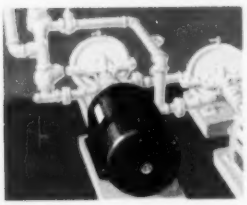
WANT TO SEE FOR YOURSELF? Tri-Clad motors in nearly all types and ratings are ready for **IMMEDIATE SHIPMENT.** Contact your nearest G-E Office or write *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

There's a Tri-Clad motor for every industrial need!

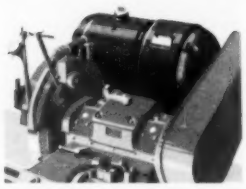


G-E open (drippproof) induction motors for constant-load, constant-speed applications. From 1 to 2000 hp.



G-E totally enclosed motors for operation where dust or corrosive fumes are a hazard. From 1 to 1000 hp.

G-E capacitor motors for use on fans, blowers, pumps and compressors with single-phase power. From ¾ to 5 hp.



G-E Type ACA induction motors for adjustable speeds—provide 3 to 1 speed range. From 3 to 200 hp.

YOU CAN'T BEAT
TRI CLAD
EXTRA
PROTECTION

Photograph made at the Shaw plant showing checking, during production, of recording instruments of heat treating furnaces.

Shaw safeguards the quality of your piping contract by accurate, scientific control during every step in production. Any size piping contract is a Shaw contract. Service is flexible, economical. Write for information.

Benjamin F. Shaw Company is qualified to pre-fabricate and erect piping throughout the world

Benj. F. Shaw III

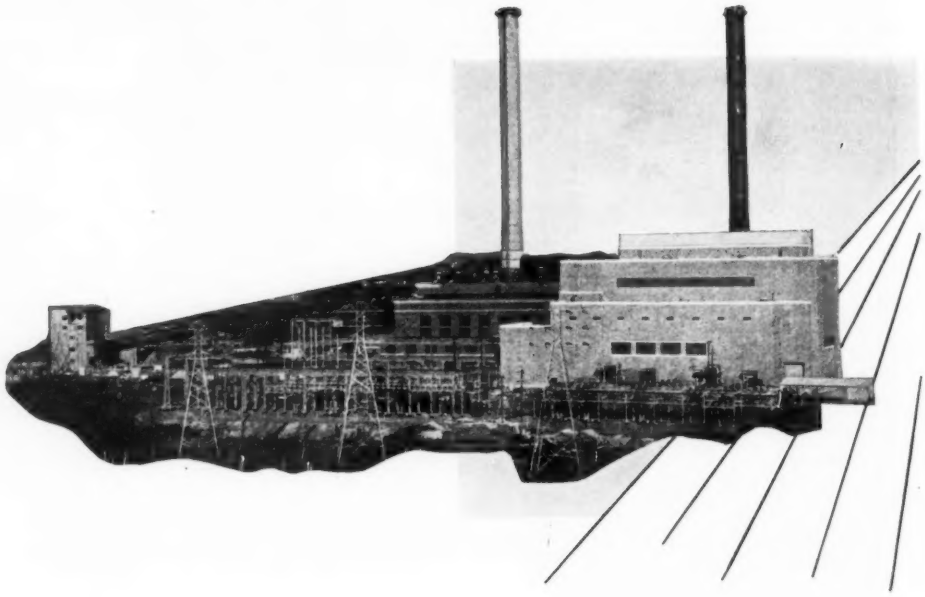
President

BENJAMIN F. SHAW COMPANY

2nd and Lombard Streets Wilmington, Delaware

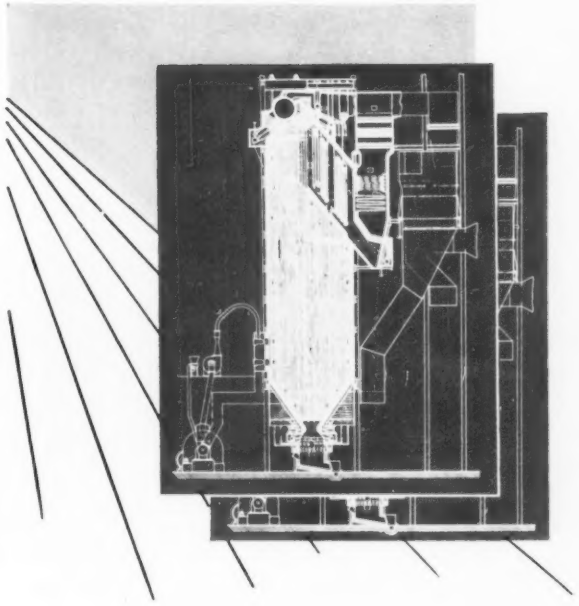
KNOWN SINCE 1893 FOR HIGH-QUALITY PIPING PRE-FABRICATION AND INSTALLATION

Looking ahead



The new extension of the Barbadoes Station of the Philadelphia Electric Company houses two large Foster Wheeler steam generators which are capable of producing a total of 1,200,000 lb of steam per hr. The units will serve two turbine generators with an aggregate capacity of 132,000 kw.

These single-pass, baffleless steam generators having liberal furnace dimensions, are based on what is now known as the "Preferred Standard" design which promises both first cost savings and long range economy. The design also embodies Foster Wheeler features of slag-free fur-



TWO FOSTER WHEELER STEAM GENERATING UNITS for BARBADOES STATION PHILADELPHIA ELECTRIC CO.

Steam Capacity per Unit
600,000 lb per hr

Superheat Control Range
330,000 to 600,000 lb per hr

Pressure Superheater Outlet
825 psi

Final Steam Temperature
900 F

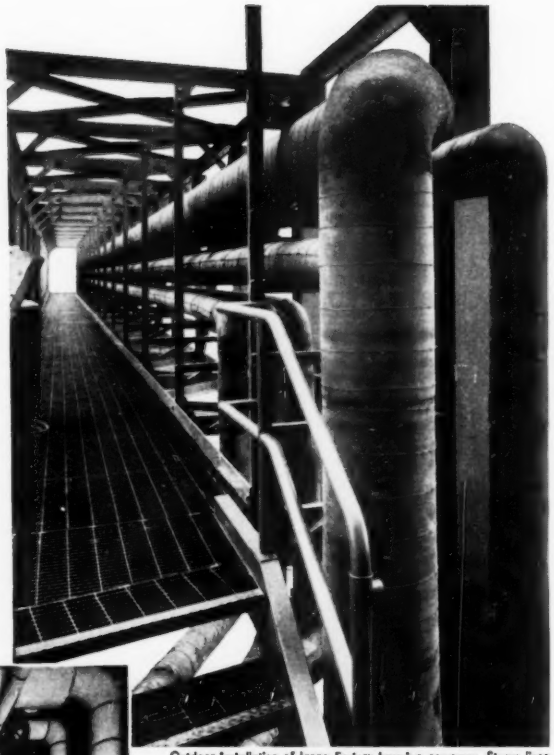
Bituminous Coal Pulverized in FW Ball Mills (two per unit)

nace arrangement, Foster Wheeler condenser-type steam temperature control, low draft loss, and efficient heat recovery arrangement. Each steam generator is equipped with two Foster Wheeler ball mill pulverizers.

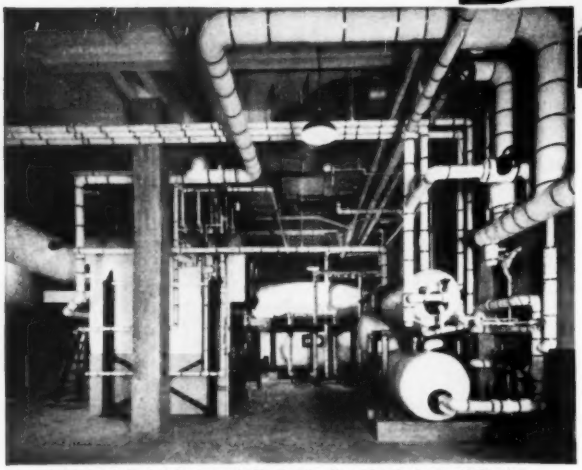
FOSTER WHEELER CORPORATION
165 BROADWAY, NEW YORK 6, NEW YORK.

FOSTER FW WHEELER

Two tough steam jobs
INDOORS
OUTDOORS
Efficiently handled with
K&M "FEATHERWEIGHT"
85% Magnesia Insulation



Outdoor installation of large Eastern brewing company. Steam lines covered with double standard thickness "Featherweight" 85% Magnesia Pipe Insulation and weatherproof jacket.



Indoor installation in boiler room of office building. Steam lines insulated with "Featherweight" 85% Magnesia Pipe Insulation and boilers insulated with K&M Insulating Cement.

This outdoor installation required especially dependable steam pressure control . . . since the equipment was part of a large brewing operation. K&M "Featherweight" 85% Magnesia Insulation was specified and excellent results obtained. The indoor heating system required efficient temperature control . . . "Featherweight" solved the problem here. Indoors or out . . . when it's an insulation job . . . that's the place for K&M "Featherweight" 85% Magnesia Insulation.

"Featherweight" 85% Magnesia Insulation combines the high insulating properties of basic Carbonate of Magnesia with asbestos fibers as a binding agent . . . forming a lightweight, fireproof, efficient insulating material.

K&M Distributors, located strategically throughout the country, are experts on the application of K&M insulating materials . . . and can point the way to savings for you. Write us for further information.

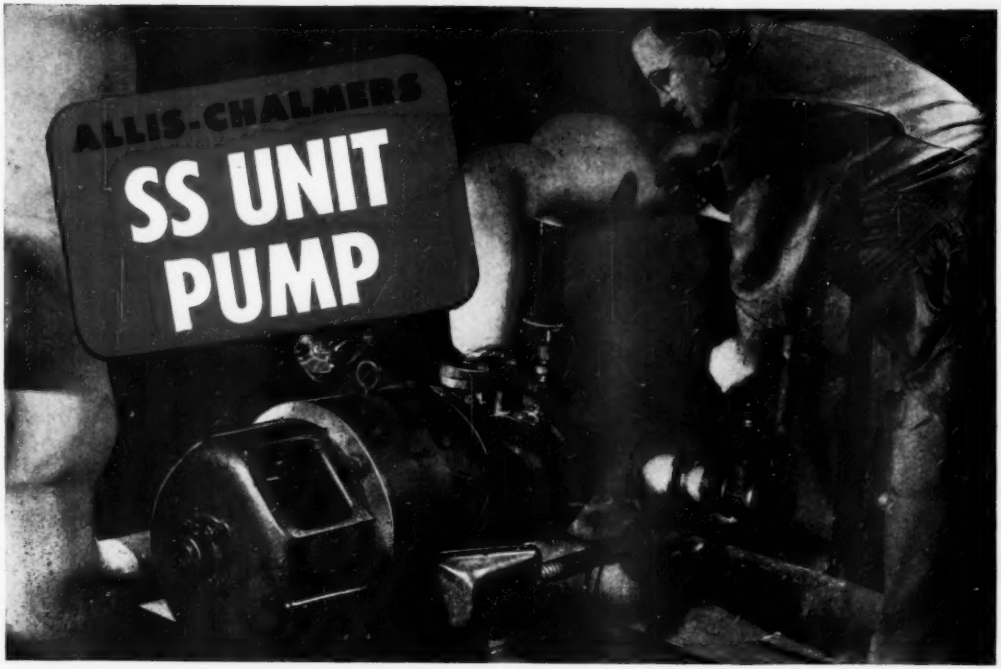
K&M best in asbestos

Nature made Asbestos

Keasbey & Mattison Company has made it serve mankind since 1873.

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

IN CANADA — ATLAS ASBESTOS CO., LTD., MONTREAL, TORONTO, WINNIPEG AND VANCOUVER



50% MORE WATER
33% LESS POWER

"Our *old* displacement pump required 15 hp motor to raise 100 gpm 110 ft to roof tanks. *Now* this A-C SS Unit Pump Lifts 150 gpm to same tanks with only a 10 hp motor!"

THAT'S THE EXPERIENCE, along with worthwhile savings in space and maintenance, reported by the chief engineer of a large commercial building.

It is the kind of saving that you, too, may be able to make with Allis-Chalmers SS Unit Pumps. Here are 4 reasons why:—

Deliver Rated Efficiencies — Every unit tested at the factory and the performance curve plotted. Efficiency is proved.

Heavy Construction — Compare section thicknesses, shaft diameters and other features. See why SS Unit Pumps run years without repairs.

Easy Maintenance — Compact design and few parts reduce maintenance. Bronze ring protects casing from wear. Is easily replaced when required.

Application Engineering — When a pump is recommended by an A-C Pump Application Engineer, you know that you are getting the pump that fits your needs exactly and that will give you dependable service at low cost per gallon.

SS Unit is one of many Allis-Chalmers models for most industrial pumping services. For information, see your Allis-Chalmers Authorized Dealer or District Office. Or write for Bulletin 52B6059E. Also listed in Sweet's. A 2595

SS Unit, Texrope and *Vari-Pitch* are Allis-Chalmers trademarks.

ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE, WIS.

ALLIS-CHALMERS

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and District Offices throughout the country.

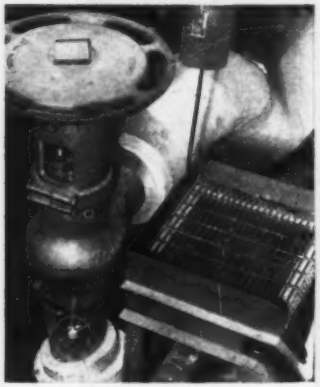
MOTORS — ½ to 25,000 HP and up. Matching Allis-Chalmers Control.

TEXROPE — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.

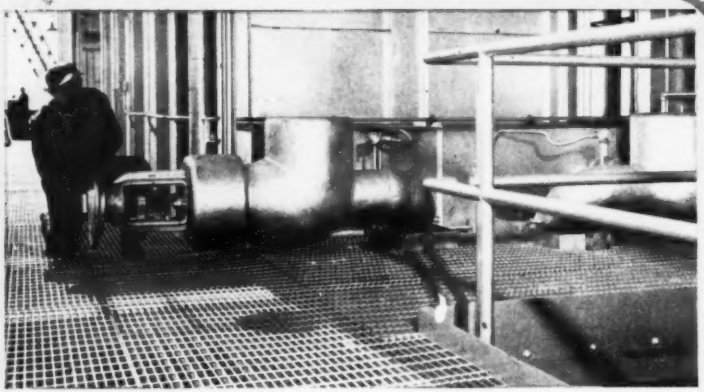
PUMPS — Integral motor and coupled types. Sizes and ratings to 2500 GPM.

97% of New Power Plants

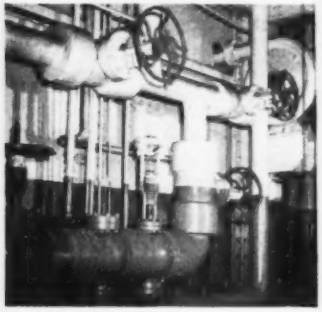
THESE ARE TYPICAL NEW EDWARD INSTALLATIONS



NON-RETURN VALVES—Edward pressure-seal bonnet non-return valve installed in new 1300 lb, 950 F middle western central station. Valve is equipped with Edward Impactor handwheel.

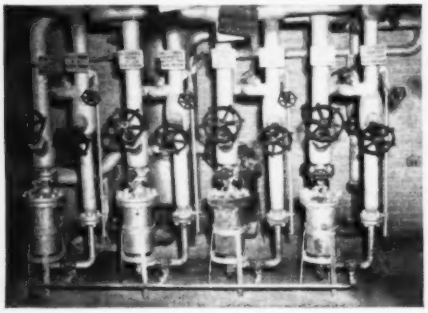


FEEDLINE VALVES—Two separated type Edward stop-check valves on 5 in. boiler feedlines of new West Coast semi-outdoor power plant. By all odds the most widely used steel valves for feedline service, Edward stop-checks are built in both screwdown and separated type.



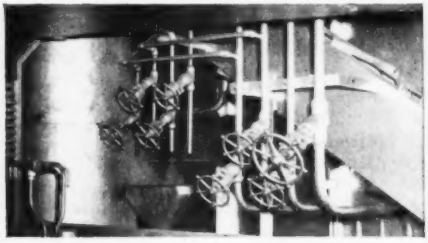
GATE VALVES—Edward 600 lb gate valves, with ball bearing yokes and welded in hard-faced seats, in modern power plant of major point manufacturer.

BLOW-OFF VALVES—Interesting piping arrangement of 1500 lb Edward blow-off valves in famous North Central area generating station.



FORGED STEEL VALVES—A variety of sizes of Edward Fig. 2688 valves on trap lines of large central station located in the northwestern area.

Edward builds the world's most complete line of steel power plant valves—gate, globe and angle stop, non-return, check, feedline stop-check, blow-off, Intex, Univalve, gage, hydraulic, relief valves and strainers for service from 150 to 7500 lb with bolted, screwed, welded or pressure-seal bonnet connections and with flanged, screwed or welding end connections. Write for catalogs.

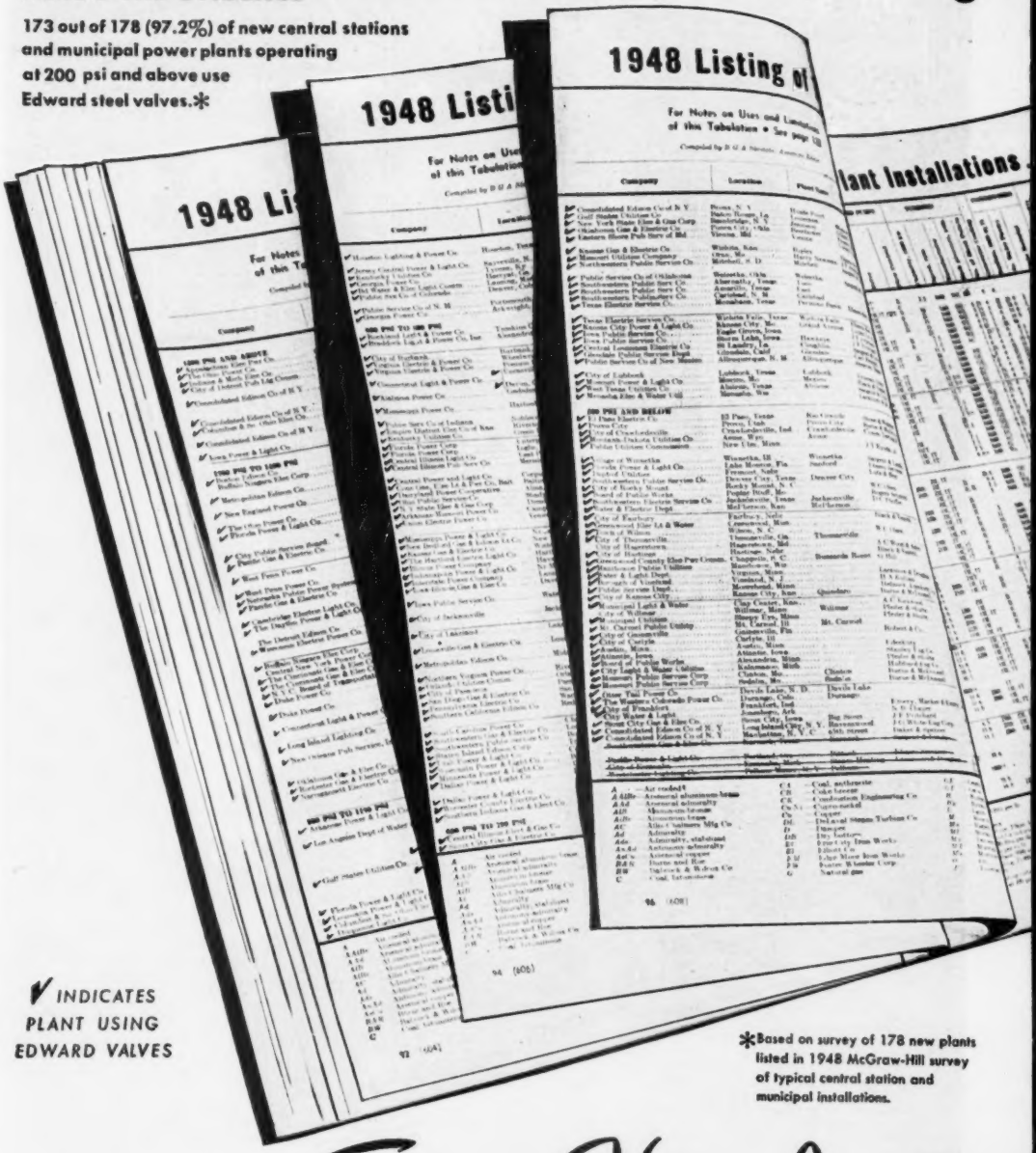


UNIVALVES—Patented Edward welded bonnet Univalves for 1500 lb at 1000 F are among 2185 Edward valves installed in one new 260,000 kw station

Use Edward VALVES !

HERE'S THE EVIDENCE

173 out of 178 (97.2%) of new central stations and municipal power plants operating at 200 psi and above use Edward steel valves.*



✔ INDICATES PLANT USING EDWARD VALVES

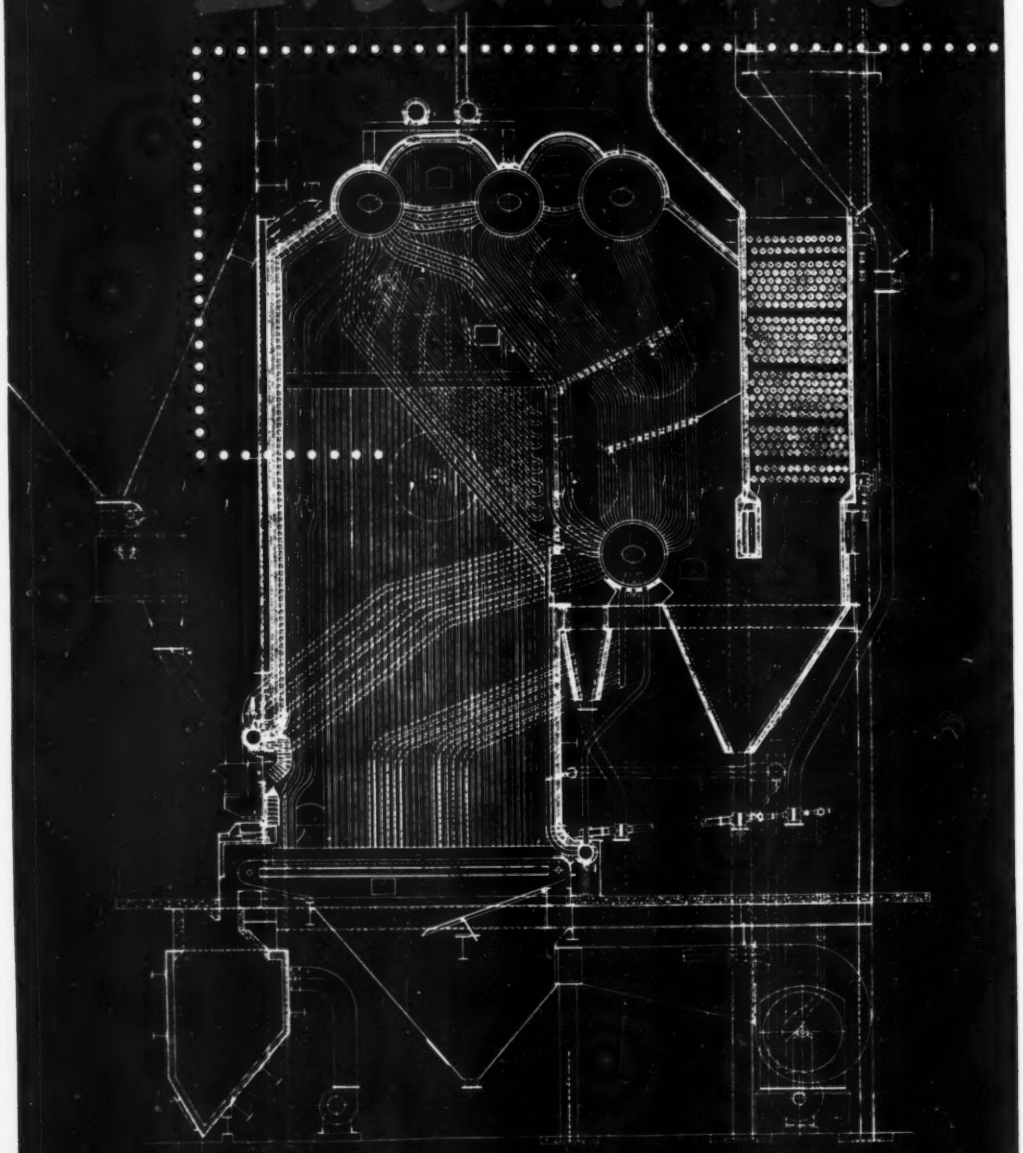
*Based on survey of 178 new plants listed in 1948 McGraw-Hill survey of typical central station and municipal installations.

Edward Valves, Inc.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO. EAST CHICAGO, INDIANA

AT RIVER RAISIN PAPER CO.

IT'S *Electrunite*



Boiler Tubes

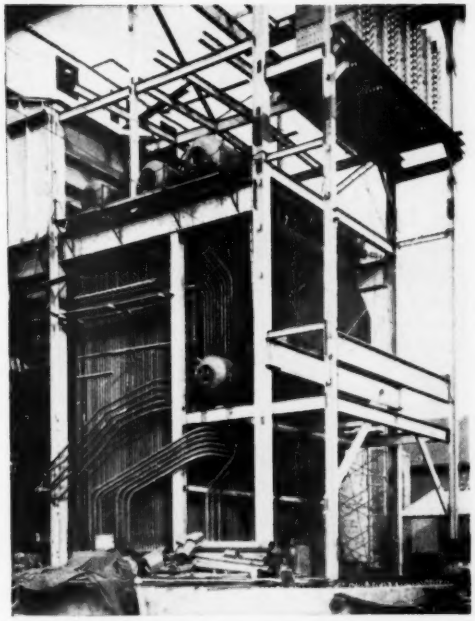
IN NEW 4-DRUM BOILER INSTALLATION AT MONROE, MICHIGAN MAIN PLANT

● Specifications for this modern Wickes Boiler installation at River Raisin Paper Company include: 180,000 pounds steam per hour capacity; design pressure, 700 pounds per square inch; and total temperature, 750°F. As in countless new equipment installations, Republic ELECTRUNITE Boiler Tubes were used exculsively.

The reason? Typical ELECTRUNITE advantages, resulting from Republic's improved methods of producing these sound, strong, modern boiler tubes. Because each tube is uniformly ductile, straight and round, they effectively cut installation time and costs. Equally important, from an operating standpoint, are the freedom from rolled-in scale and inside surface defects—throughout every length and every shipment—which mean positive assurance of long, trouble-free tube service.

Whether you are specifying new boiler equipment, or retubing old units, you'll find it well worth the time to investigate all of the money-saving advantages of ELECTRUNITE Boiler Tubes. Informative literature and technical data are available upon request. Write *today* to:

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, New York



Among the advantages of this 4-Drum Wickes Boiler, according to the manufacturer, are large diameter drums, minimum number of tube bends, and steam liberating area large enough to insure rapid response to load changes. Consulting Eng'rs.: Cummins & Barnard, Inc., Ann Arbor, Mich.

Republic
REPUBLIC STEEL
ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

Another new plant specifies

LUNKENHEIMER

Fig. 2228 UNION BONNET GATE VALVES

chosen for extra and positive

Fig. 2228
Screw Ends
Fig. 2229
Flange Ends
Double disc rising stem.

THE accompanying views in the modern paint manufacturing plant of W. P. Fuller & Co., show the application of hundreds of Fig. 2228 valves on solvent processing operations. LUNKENHEIMER Fig. 2228 carries a pressure rating of 200 lbs. steam (400 lbs. water, oil and gas) making the valve suitable for a wide range of power plant uses as well as industrial services.

These valves, selected for plants from coast to coast, embody traditional LUNKENHEIMER quality, assure longer valve service, lower operating costs and greater dependability. The same advantages are available *and* important to you. Write for details today.

ESTABLISHED 1862
THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI 14, OHIO, U. S. A.
NEW YORK 13 · CHICAGO 6
BOSTON 10 · PHILADELPHIA 34
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK 13, N. Y.

(Left)
Union Bonnet
¼ to 2 inches
Fig. 2230 — Screw Ends
Fig. 2231 — Flange Ends
Wedge Disc, Non-rising Stem

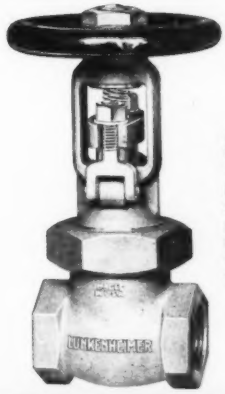
(Right)
2½" and 3" sizes, all patterns have bolted bonnet instead of union bonnet.

LUNKENHEIMER

strength tightness!

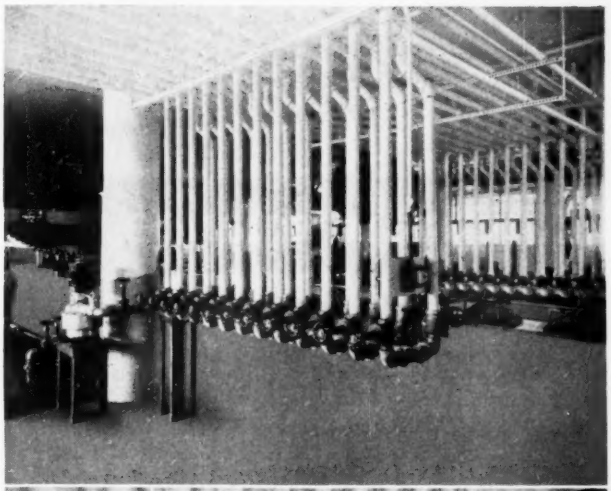
YOUR LUNKENHEIMER DISTRIBUTOR will gladly show you how this valve's extra strength means extra service, extra value too! Ask for Circular 534 or write direct.

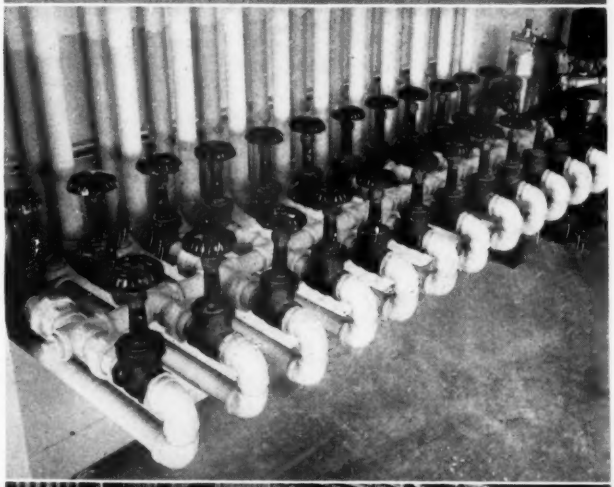
Views in modern plant of W. P. Fuller & Co., pioneer western paint mfgrs., San Francisco, Cal. Mech. and elec. engineer: G. M. Simonson. Mech. contr.: Scott Co., San Francisco.

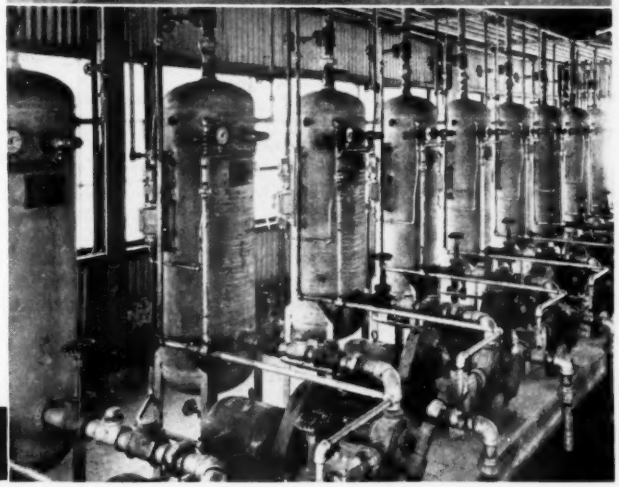


O. S. & Y. Union Bonnet
¾ to 2 inches
Fig. 2232 — Screw Ends
Fig. 2233 — Flange Ends
Wedge Disc, Rising Stem

VALVES







low maintenance

ROCKING CONTACT

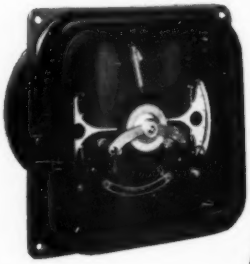
with Allis-Chalmers
ROCKING CONTACT
Generator Voltage Regulator

DESIGNED to be trouble-free. No complex adjustments, no vibrating contacts, no gliding friction. They've all been eliminated to reduce your maintenance problems.

The Rocking Contact principle means instant response, accuracy, and dependability, too. The regulator operates directly in the exciter shunt field circuit, without relays . . . and contact sectors rock on jeweled bearings. It's precision-built; yet simple design makes it capable of years of dependable service.

Rocking Contact Generator Voltage Regulators are available for both a-c and d-c generators of any size and speed, for either parallel operation or unit control. Call our qualified representative in your nearby A-C sales office or write direct. A 2586

ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE, WIS.



Type 366 Rocking Contact Regulator. Compact design means easy installation on switchboards.

ALLIS-CHALMERS
Pioneers in Power and Electrical Equipment From Generation Through Utilization

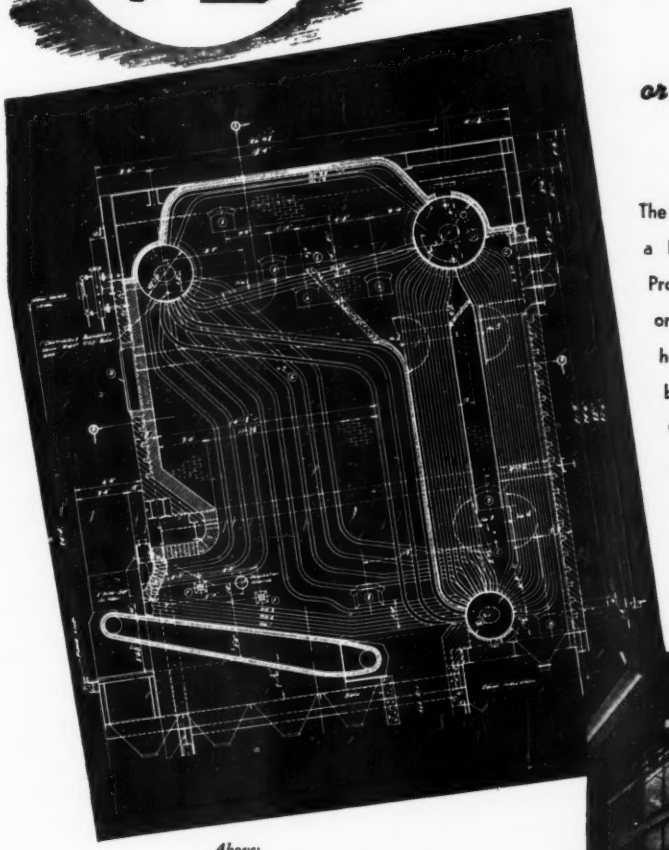
CLASS **VL**

Vogt

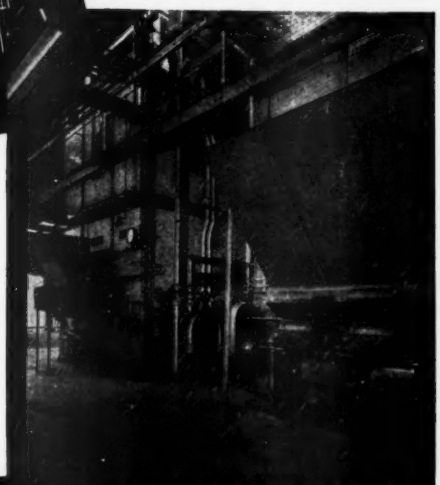
Steam Generating Units

for POWER *or* PROCESSING LOADS, *and* HEATING

The design provides large furnace volume and a high ratio of radiant heating surface. Proper combustion is assured with any fuel or method of firing. Superheaters, air preheaters, economizers, water walls, and soot blowers can be readily incorporated. Vogt Class VL Steam generating units are giving satisfactory service in Hotels, Sugar Refineries, Steel Mills, Furniture Factories, Distilleries, Oil Refineries, and related industries. A bulletin showing typical installations will be sent upon request.

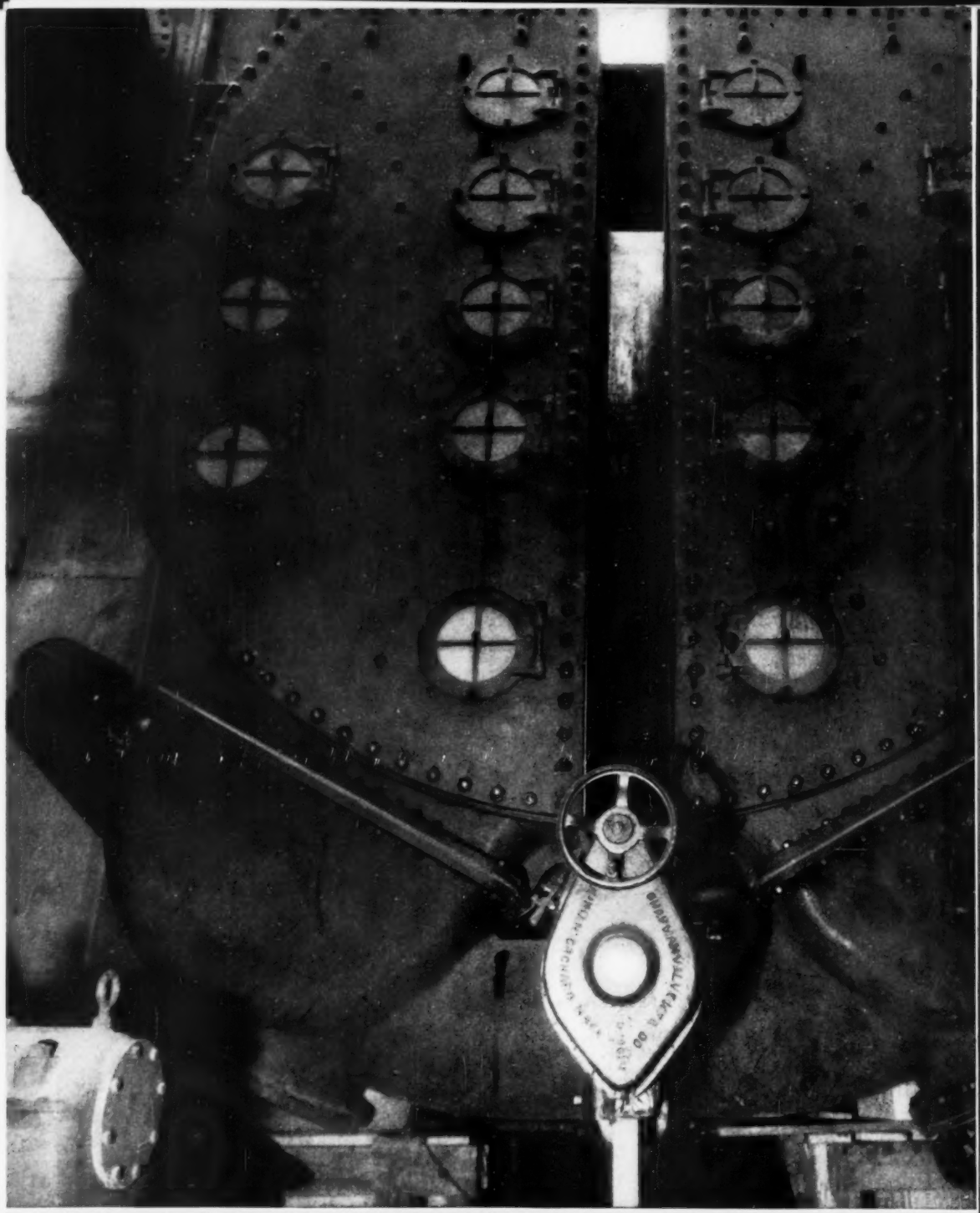


Above:
This 90,000 lbs. steam per hour unit, designed for 475 lbs. pressure, serves the Mansfield Tire & Rubber Co., Mansfield, Ohio.



Right:
Two 515 H.P. units installed in Brown-Forman Distillers Corporation, Louisville, Ky. Plant.

HENRY VOGT MACHINE CO. • 1000 W. Ormsby St., Louisville 10, Ky.
Branch Offices: New York, Philadelphia, Cleveland, Chicago, St. Louis, Dallas



C. H. Wheeler

50,000 Sq. Ft., 2 Pass Reverse Flow Condenser

Under 60,000 K. W. Steam Turbine

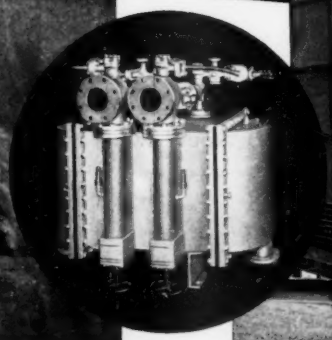
A certain large public utility (name on request) faced the problem of leaves, trash and other refuse in their only available supply of condenser circulating water. They could have installed a standard condenser, but they found many advantages, including money saving, in selecting a C. H. Wheeler Patented "Reverse Flow" Condenser. Periodic reversal of water flow automatically cleans the tubes and tube sheets of this condenser, without loss in efficiency. Installation was simplified with the C. H. Wheeler "Reverse Flow" because it does not require any additional piping over that of a standard condenser. Photo shows this installation nearly completed. Note the two C. H. Wheeler Circulating Pumps which partly show in the foreground; also the Cross Over Valve for operation with one circulating pump. Condenser is equipped with C. H. Wheeler Steam Jet Ejectors and C. H. Wheeler Condensate Pumps. Write for more information about "Reverse Flow" or Standard "Dual Bank" Condensers, described in Catalog No. 1461.

C. H. WHEELER MANUFACTURING CO.

Sedgley Avenue, Philadelphia 32, Penna.

REPRESENTATIVES IN MOST PRINCIPAL CITIES

Right—C. H. Wheeler Induced Draft Water Cooling Tower built with steel casing, as illustrated, or entirely of redwood. Circle—Tubejet Steam Jet Ejector for power plant service; also one to five stage units for process application. Catalogs on request.



STEAM CONDENSERS • WATER COOLING TOWERS
EJECTORS • STEAM JET VACUUM REFRIGERATION

OF PHILADELPHIA

"We Were Able To *Increase* The *Load* On A Bus Duct Without Changing Fuse Holders"

"In May, 1945, we moved considerable electrical equipment from a plant in Buffalo to a new plant at Niagara Falls. Several runs of bus duct were moved and installed with some load added.

"The fusible swing-out plugs in the bus duct system were 60 ampere capacity. It was soon found that 60 ampere ordinary fuses would not handle the starting surges or other temporary overloads caused by the additional equipment on the circuit.

"Our Electrical Engineer suggested Fusetron dual-element fuses. The troublesome, needless blows were stopped immediately.

"The Fusetron fuses permitted all machines to be kept in operation without any change in the size of the fuse holders."

Ferguson Electric Construction Co.,
Buffalo, N. Y.
C. P. Wachtel, Vice President

Simply by Installing

Facts About FUSETRON Dual-Element FUSES

The fuse link element opens on short-circuit — the thermal cutout element protects on overloads — the result, a fuse with tremendous time-lag and much less electrical resistance.

They have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimensions as ordinary fuses — fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

FUSETRON is a trade mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.

Fusetron DUAL-ELEMENT Fuses

with their

10 Point Protection

1. Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

Stop Wasting Time and Money —

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

FUSETRON Dual-Element Fuses Give ALL-PURPOSE PROTECTION

One needless shutdown — or one lost motor — or one destroyed switch or panel — may cost you far more than replacing every ordinary fuse with a FUSETRON Dual-Element fuse.

Don't risk such losses — protect yourself by installing a FUSETRON Dual-Element fuse in every set of fuse clips throughout the entire electrical system.

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)

Please send me complete facts about Fusetron Dual-Element Fuses.

Name _____

Title _____

Company _____

Address _____

City & Zone _____ *State* _____ 349

30-YEAR OLD MONEL PUMP RODS OUTLAST OTHERS 9 TO 1

Fairbanks-Morse sump pump. The 30-year old MONEL pump rods have never been replaced or reground, show very little wear, and seldom need repacking.

In the basement power plant of a large building in New York City, two pumps work side-by-side.

Both pumps handle a sump mixture of gritty ash-quenching waters, polluted waters from ground seepage, corrosive waters from coal drainage.

Identical service...but their maintenance stories are far from identical!

In 1918, MONEL* rods were installed in the first pump, a Fairbanks-Morse. These *rods are still giving perfect service today, thirty years later.*

The second pump (not a Fairbanks-Morse) originally had bronze rods. In the first ten years of service, these rods were replaced *three times.* In 1935, MONEL rods were installed. They have been giving perfect service ever since...*for thirteen years.*

The chief engineer says of the MONEL rods: "In my opinion, they will last as long as the pumps."

This is a story worth remembering next time you need pump rods, new or replacement. For when you specify MONEL, you get a "task metal"...one that is rustproof, corrosion-resistant, stronger than structural steel, hard, tough, yet readily machinable.

If your problem involves corrosion or excessive wear of working parts, why not write to Bob Johnson of INCO? He may be able to help you find a solution.

*Reg. U.S. Pat. Off.

MONEL

...FOR MINIMUM MAINTENANCE

EMBLEM OF SERVICE INCO TRADE MARK

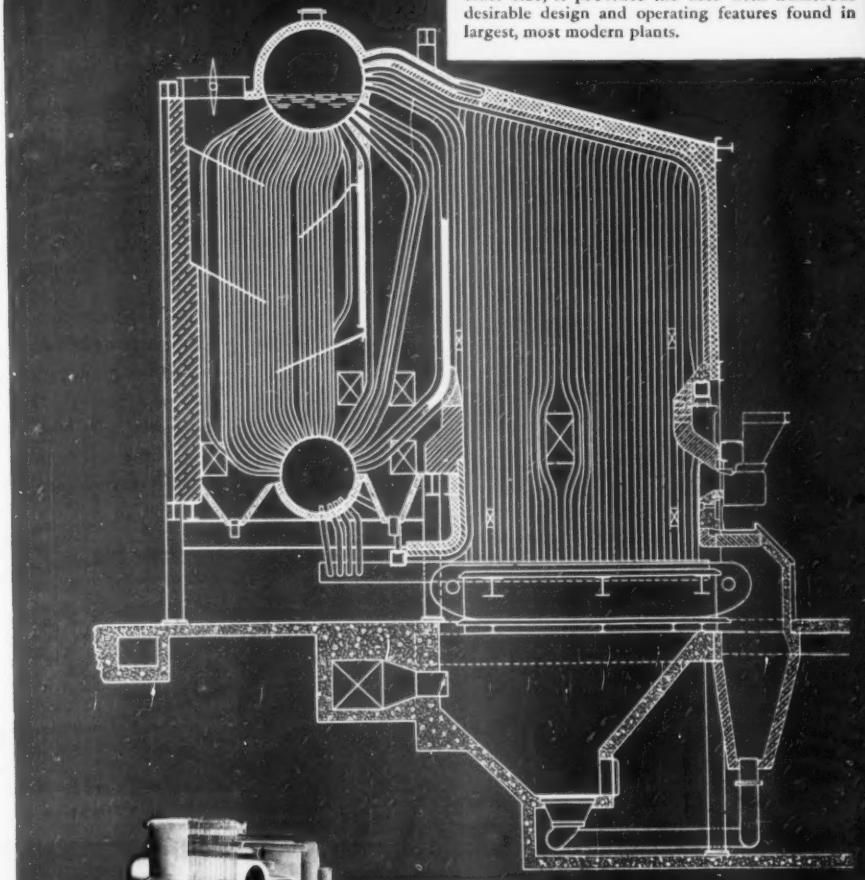
THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street, New York 5, N. Y.

"To Meet User's Needs"

HERE is another example of a new two drum steam generator by Springfield that has been designed to meet the user's particular requirements. It is equipped to operate on Illinois coals with continuous ash discharge spreader stoker. Occupying less than 300 sq. ft. of floor space, the unit will produce 30,000 lbs. of steam per hour at an operating pressure of 150 p.s.i. Although of only moderate size, it provides the user with numerous desirable design and operating features found in largest, most modern plants.

Location:
SANGAMO ELECTRIC CO.
Springfield, Ill.



See our catalog in SWEET'S

SPRINGFIELD BOILERS

CHECK WITH YOUR CONSULTING ENGINEER ON YOUR MODERNIZATION AND NEW PLANT PROJECTS

SPRINGFIELD PRODUCTS

BENT TUBE STEAM GENERATORS—Modern designs for capacities from 10,000 lbs. up.

STRAIGHT TUBE BOILERS—Specially designed for capacities from 5,000 to 450,000 lbs. per hour and higher.

STANDARDIZED TYPE M BOILERS—Standardized for quicker delivery and lower cost. Sizes 6,000 to 17,000 lbs. per hour.

WATER COOLED FURNACES—Heavy duty water walls. Exclusive center water wall construction for larger units.

SUPERHEATERS — AIR HEATERS — ECONOMIZERS—Individually designed to meet requirements.

SPRINGFIELD BOILER CO.

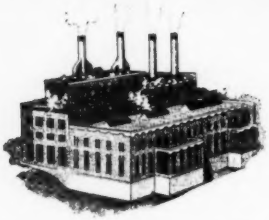
1953 E. Capitol Ave. Springfield, Illinois

WORLDWIDE SALES AND SERVICE

NEW YORK • PHILADELPHIA • WASHINGTON, D. C. • DETROIT • SALEM, MASS. • HOUSTON
CHICAGO • SAN FRANCISCO • ST. LOUIS • CINCINNATI • MEXICO, D. F. • BUENOS AIRES

Export: READING, PA

COCHRANE DEAERATORS AT CLIFFSIDE



The initial operation of the final unit of the Cliffside Station of the Duke Power Company, which brings the total output of this great generating station to 210,000 KW finds Cochrane Deaerators contributing to this project, as they have to the earlier units at Cliffside and to other Duke Power stations in the South.

Cochrane Deaerators are protecting the boilers, piping and turbines of the Duke stations listed below against rust and corrosion by removing excess oxygen and other corrosive gases from the feedwater, and aiding in their efficient operation by heating that feedwater to steam temperature.

Details of any of these installations or descriptive bulletin may be obtained by writing

COCHRANE CORPORATION
3106 N. 17th St. • Philadelphia 32, Pa.

DUKE STATIONS equipped with COCHRANE DEAERATORS and Feedwater Heaters

CLIFFSIDE
Two 375,000 lb/hr Deaerators
Two 600,000 lb/hr Deaerators
Two 8,000 lb/hr Open Heaters

BUCK
One 725,000 lb/hr Deaerator
Two 500,000 lb/hr Deaerators

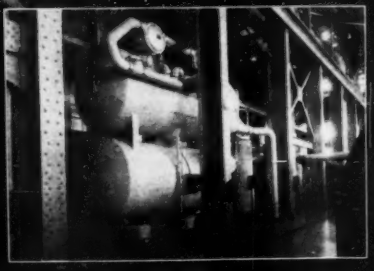
TIGER
One 540,000 lb/hr Open Heater

MOUNT HOLLY
Two 270,000 lb/hr Open Heaters

ENO
One 270,000 lb/hr Open Heater

DAN RIVER
Two 650,000 lb/hr Deaerators

COCHRANE CORPORATION 86 YEARS OF SERVICE 1863-1949



COCHRANE

SOFTENERS • FILTERS • DEAERATORS • CONTINUOUS BLOW-OFF SYSTEMS

IDEAL FOR PACKING FLANGES OR JOINTS

ANKORITE NO. 424 COMPRESSED ASBESTOS SHEET PACKING
PLAIN OR GRAPHITED

ANKORITE NO. 424 is a superlative Compressed Sheet Packing adaptable for packing flanges or joints against high pressure, super-heated or saturated steam, hot or cold water, gases, ammonia, hot or cold oil, and many chemicals.

ANKORITE NO. 424 is a dark gray color and is manufactured from long fibre asbestos bonded with heat-resisting compounds, compressed and bonded under high pressure.

ANKORITE NO. 424 has great tensile strength and will not shrink or deteriorate in the joints.

ANKORITE NO. 424 is furnished in sheets 50" x 50", 50" x 100" or 50" x 150", in all thicknesses from 1/64" up to ¼" inclusive.

ANKORITE NO. 424 is carried in stock in all our Branches.

BRANCH OFFICES

BALTIMORE, MD.
BOSTON, MASS.
BUFFALO, N.Y.
CINCINNATI, OHIO
CHICAGO, ILL.
CLEVELAND, OHIO
DAYTON, OHIO
DETROIT, MICH.
HOUSTON, TEX.
INDIANAPOLIS, IND.
LOS ANGELES, CAL.
MILWAUKEE, WIS.
MONTREAL, CANADA
NEW ORLEANS, LA.
NEW YORK, N.Y.
PHILADELPHIA, PA.
PITTSBURGH, PA.
SAN FRANCISCO, CAL.
SEATTLE, WASH.
SPOKANE, WASH.
ST. LOUIS, MO.
TOLEDO, OHIO
WILMINGTON, CAL.

THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.

FACTORIES: MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

an old installation brought a new installation of

HAGAN Controls

at MARION POWER SHOVEL COMPANY

Hagan Controls had been in service for 15 years at the plant of Marion Power Shovel Company, Marion, Ohio, when the Company decided to replace the old boilers and modernize its power plant. This long experience with Hagan controls was a major factor in their selection of Hagan Controls and Hagan Ring Balance Meters for the new boilers.

The new boilers are rated at 35,000 lb./hr. at 125 lb. pressure. They are stoker fired, using a spreader type stoker.

During the summer, steam demand ranges from 2,000 to 15,000 lb./hr. Base demand in winter is much higher, for steam is used to heat 20 buildings of various types, spread over 25 acres of ground. Winter load, therefore, may vary between 50,000 and 63,000 lb./hr. Steam hammers are used in the factory, and when the hammer line goes on, demand may increase almost instantly by as much as 13,000 lb./hr.

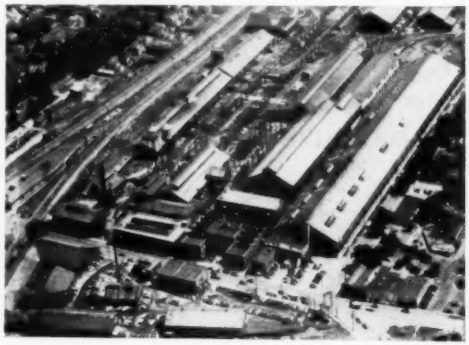
The boiler meter chart at the right shows how closely the boilers follow fluctuations in demand. Careful records of coal produced and steam consumed show that boiler efficiency runs slightly over 79%, with load at approximately 55% of rating. CO_2 tests range from 13.5% to 13.8%.

The Hagan Ring Balance Steam Flow-Air Flow Meters are of the simple two-pen recording type, with integrators which give a continuous indication of total flow.

HAGAN CORPORATION

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES

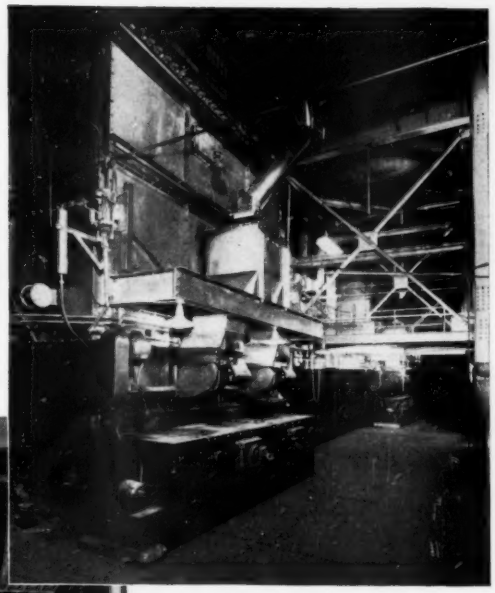
For full information about Hagan Automatic Combustion Controls and Hagan Ring Balance Meters, write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pennsylvania.

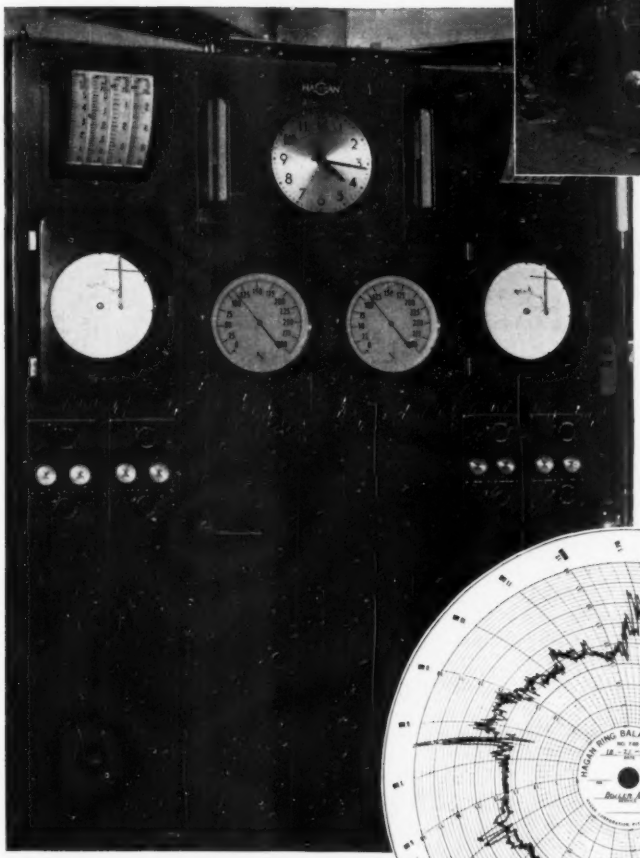


Boilers provide steam heat for 20 buildings of all types, spread over 25 acres of ground.

This giant shovel is typical of the Company's products. Scoop will hold 40 cubic yards of earth; cab is as large as the average house.

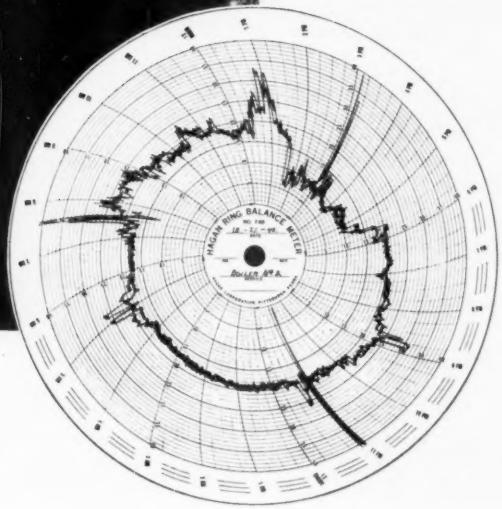
and Meters



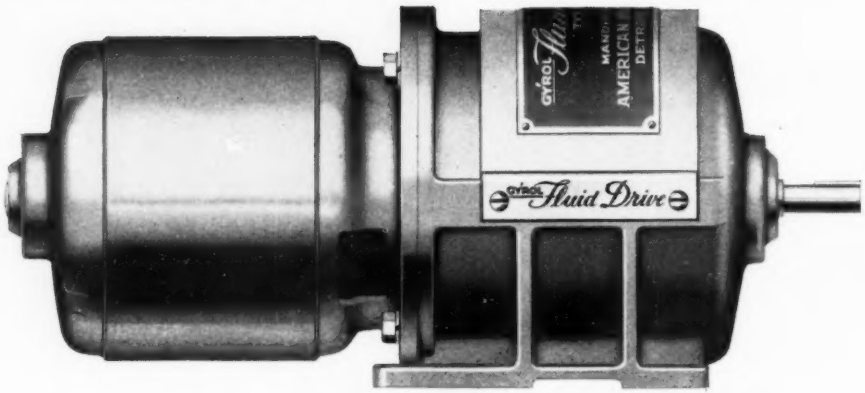


Boiler room of Marion Power Shovel Company, Marion, O. The installation was designed and supervised by Frederick L. Smith Co., consulting engineers, New York, N. Y., and Rex Kilbourn, Plant Engineer of the Marion company.

Control Panel is located at the center of the wall facing the boilers.



NEW GYROL FLUID DRIVE HYDRAULIC ELECTRIC POWER UNITS



S-M-O-O-T-H POWER

Now, for the first time, you can buy Hydraulic Electric Power Units with built-in Gyrol Fluid Drive for all your tough jobs requiring electric motors, such as—conveyors, centrifugals, mixers, winders, spinners, and other machines where low starting current, smooth acceleration, overload protection and shock absorption are highly desirable characteristics.

And you can get these new units, equipped with frames made to standard NEMA mounting bolt hole dimensions and powered by dependable, constant speed AC motors.

No on-the-job engineering is necessary. No expensive controls are required. Wiring is actually simplified. Read these advantages:

At the snap of a switch, the motor starts unloaded and comes up to 85% of full speed before starting the load. This saves more than 50% in current usually expended in starting. It eliminates the need to overmotor jobs . . . gives complete protection from shock to both motor and driven machinery.

Acceleration is positive but gradual, without vibration or jerking. There's no metal-to-metal connection between driving unit and driven machinery. Shocks are absorbed in a cushion of oil. Simply adjusting the oil level in fluid drive adjusts the degree of load transmitted by the motor.

Thus, Gyrol Fluid Drive insures longer wear, better performance and lower upkeep costs for your machines and motors.

Units powered with 5 and 7½ HP motors are available now. Other units, powered by 1, 1½, 2, 3, 10, 15 and 20 HP motors, will be ready for fall delivery. Ask your Power Transmission Dealer for prices and data. If he cannot supply you, phone or write the nearest American Blower Branch Office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER
GYROL Fluid Drive

Serving home and industry
AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILER • ROSS HEATER • TONAWANDA IRON

PETROLEUM PROCESSING SPEEDED WITH WICKES TYPE-A STEAM GENERATORS

Profitable processing of crude petroleum into fine oils and fuels requires the most efficient equipment available. These three Wickes Type-A water tube steam generators are operating in an oil field near Delhi, Louisiana. Wickes Package Type-A Steam Generators are compactly designed and efficiently engineered for immediate installation with least possible erection problems. Units are designed for pressures up to 850 psi, producing up to 200,000 lbs. steam per hour. Write for descriptive catalog.

THE WICKES BOILER CO.

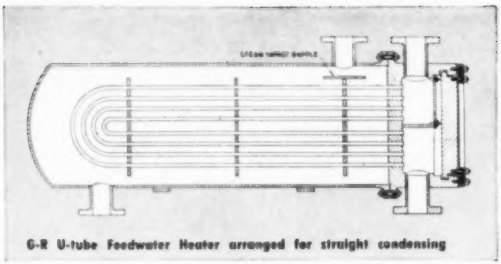
DIVISION OF THE WICKES CORPORATION • SAGINAW, MICH.

RECOGNIZED QUALITY SINCE 1854

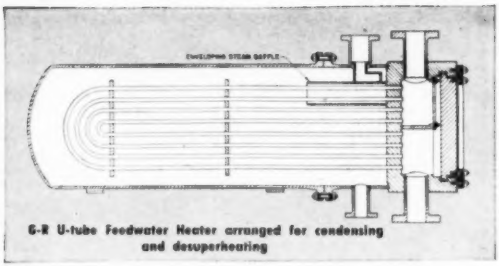
Sales Offices: Atlanta • Boston • Charlotte • Chicago • Cincinnati • Denver • Detroit • Houston • Indianapolis • Kansas City • Los Angeles Milwaukee • New York City • Pittsburgh • San Francisco • San Jose • Seattle • St. Louis • Tulsa • Saginaw • Mexico City • Buenos Aires.

PROBLEM: **To select a feedwater heater that will efficiently transfer the heat from the available steam in the shell to the boiler feed water flowing through the tubes, with lasting freedom from trouble in service.**

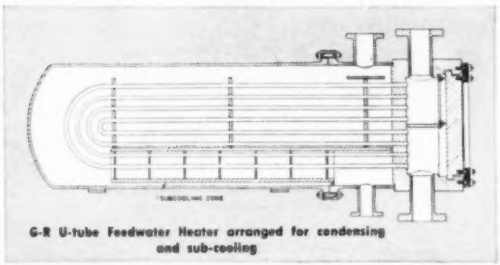
SOLUTION: A G-R FEEDWATER HEATER



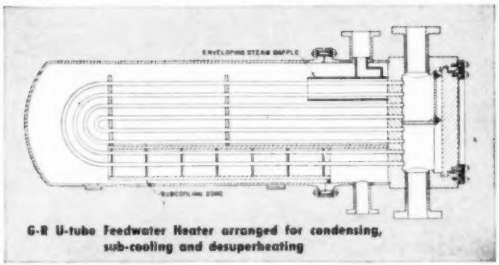
G-R U-tube Feedwater Heater arranged for straight condensing



G-R U-tube Feedwater Heater arranged for condensing and desuperheating



G-R U-tube Feedwater Heater arranged for condensing and sub-cooling



G-R U-tube Feedwater Heater arranged for condensing, sub-cooling and desuperheating

PROOF:

1. G-R Feedwater Heaters are designed for uniform steam distribution through the tube bundle—accomplished by proper proportioning and installation of steam impact baffles.

2. G-R Feedwater Heaters are baffled and supported to prevent high steam velocities, impingement of steam or drains on adjacent tubes, or vibration of tubes in support plates, and to protect the tubes from erosion and chafing.

3. G-R Feedwater Heaters are furnished with proper size of drain outlet connections to prevent backing up of condensate into the tube bundle and flooding of the heating surface.

4. G-R Feedwater Heaters for low pressures are amply relieved of air by means of an air baffle which sub-cools the vented air, thus reducing its volume and steam content.

5. G-R Feedwater Heaters cannot leak between passes at water heads because of their pass partition sealing plates which employ the pressure differential between the passes to keep the partition plate gaskets tight.

These are only some of the many superior features of G-R Feedwater Heaters . . . available in a large variety of types and sizes for all pressures and other service conditions. Write for Bulletin 279 describing these units in detail.

GR-212

THE GRISCOM-RUSSELL CO., 285 MADISON AVENUE, NEW YORK 17, N. Y.

GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS

How extra refining* makes GULFCREST a superior turbine oil

GULFCREST is superrefined by the Alchlor Process* to remove this 15%

The Gulf Alchlor Process makes Gulfcrest Oil extra pure and extra efficient.

In Cylinder 1 you see the oil that will become Gulfcrest. It has already gone through the usual steps used in refining most other turbine oils—but has not yet been Alchlor-processed.*

In Cylinder 2 you see the part—approximately 15% — discarded by the Alchlor Process.* This is the part that, when allowed to remain in turbine oil is most likely to oxidize, increase neutralization number, and form sludge, emulsifiers, and harmful acids.

In Cylinder 3 you see the finished Gulfcrest—the incomparably pure lubricating oil that gives outstanding performance and helps you keep steam turbine systems clean indefinitely. To make it even finer, special inhibitors are added to it—they give it still greater stability and protection against corrosion.

Call in a Gulf Lubrication Engineer today and ask him to recommend the proper grade of Gulfcrest Oil to meet the specific requirements of your turbines. Write, wire, or phone your nearest Gulf office.

GULF INDUSTRIAL LUBRICATION

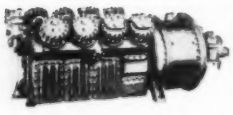
Gulf Oil Corporation · Gulf Refining Company

Division Sales Offices:

Boston · New York · Philadelphia · Pittsburgh · Atlanta
New Orleans · Houston · Louisville · Toledo

AGAIN---IT'S STURTEVANT FANS FOR NEW 200,000 KW WEST COAST STATION

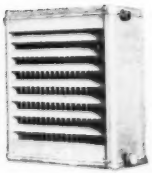
UNIT
AIR CONDITIONERS



REFRIGERATION
COMPRESSORS

Everything
that puts air to
work for
Every application

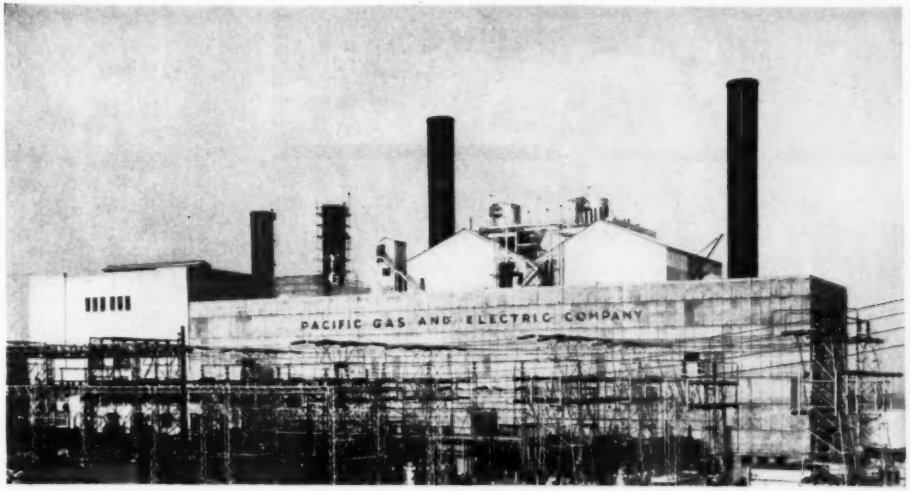
INDUSTRIAL FANS



UNIT HEATERS

VANE CONTROL

*Reg. U. S. Pat. Off. J-80130



Station P—being completed

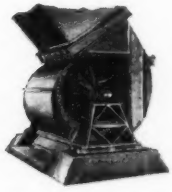
San Francisco's power supply will get a boost with two 100,000 kw generators at Station P, new Pacific Gas and Electric Company plant. Four oil and gas firing boilers will deliver 1,900,000 pounds of steam per hour to these generators. And, each of these boilers will get its mechanical draft with a Sturtevant duplex fan.

Four Sturtevant duplex fans are being installed—each consisting of a size 13½, double inlet, Multivane* Induced Draft fan and size 1012, single inlet Turbovane* for forced draft. The Multivane is equipped with damper control and the Turbovane* with Sturtevant Vane Control to regulate air volumes.

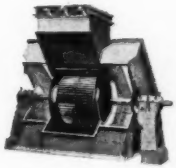
Each forced draft fan delivers 700,000 lbs. air per hour against a static pressure of 25". Each induced draft fan delivers 810,000 lbs. of gas per hour against a static pressure of 13.5", at 440°F gas temperature.

For nearly 90 years, Sturtevant Mechanical Draft equipment has been noted for dependable service in almost every major power plant in North America. Why not check on what this dependability can mean to your plant? Write for Booklet B-3801—48 pages filled with valuable mechanical draft information. Address: Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Massachusetts.

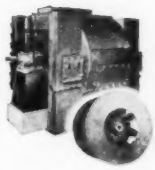
Westinghouse
Sturtevant Division



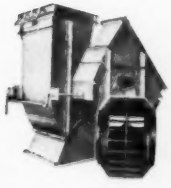
FORCED DRAFT FANS
(Turbovane*)



INDUCED DRAFT FANS
(Multivane*)

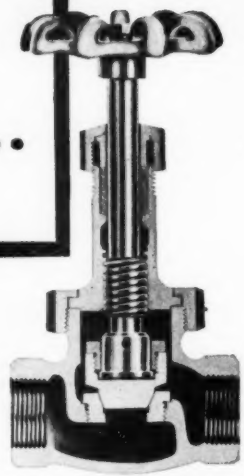


INDUCED DRAFT FANS
(Steel Plate)

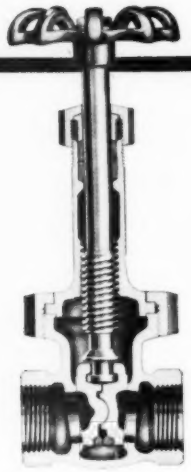


INDUCED DRAFT FANS
(Turbovane*)

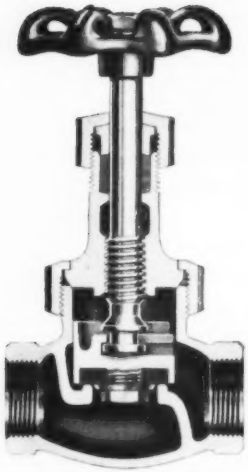
Walworth bronze valves...



Walworth No. 225P Globe Valve
500 Brinell Seat and Disc



Walworth
No. 29 Gate Valve



Walworth No. 95 Globe Valve
Re-New-Disc

built to give dependable trouble-free service on all recommended jobs

Walworth No. 95 Bronze Globe Valves (Angle Type: No. 96) are recommended for service where throttling is not required. They are rated at 150 psi working steam pressure, 500F; 300 psi cold water, oil or gas. The improved renewable disc and lock-on, slip-off disc holder — an original Walworth development—saves time and trouble. This valve can be repacked under pressure when fully opened. All parts are designed to give maximum service and strength.

Walworth No. 29 Bronze Gate Valves are rated at 200 psi working steam pressure, 550F; 400 psi cold water, oil and gas. These valves have rising stems and integral seats. Sizes 2-inch and smaller have union bonnets; sizes 2½ and 3-inch have bolted bonnets. Valves up to and including ¾-inch have solid wedge discs; 1-inch and larger have split wedge discs. These valves can be repacked under pressure when fully opened.

Walworth No. 225P Bronze Globe Valves (Angle Type: No. 227P) are rated at 350 psi working steam pressure, 550F; and 1000 psi non-shock service on cold water, oil and gas. The stainless steel, plug type seat and disc — heat treated to 500 Brinell — can be closed on sand, slag, scale and similar floatage, without injury to the seating surfaces. They are the longest wearing, TOUGHEST bronze valves you can buy.

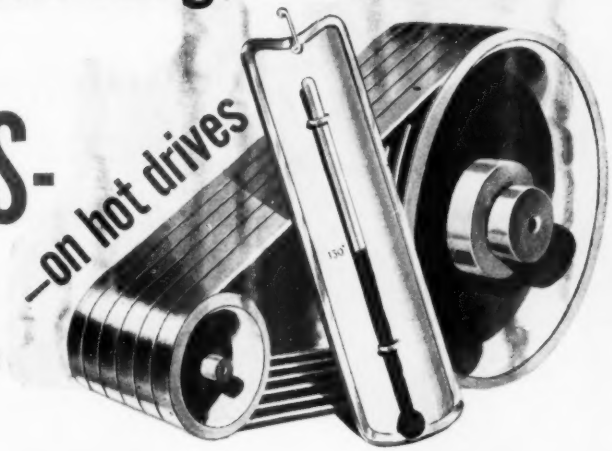
For full information about Walworth Quality Bronze Valves, see your Walworth distributor, or write:

WALWORTH
valves and fittings

60 EAST 42nd STREET NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

2 to 4 times longer belt life with COMPASS-V-STEEL —on hot drives



A LARGE New England paper mill had constant trouble V-belting their blowers. Due to the difficult operating conditions, the wide temperature ranges, conventional cord belts lasted at most six weeks.

Then the G.T.M.—Goodyear Technical Man—recommended Goodyear COMPASS-V-STEEL Belts. That ended the belt trouble. Today these steel cable belts have entirely replaced the cord variety. And, depending on temperature conditions, their average life is 3 to 6 months—*2 to 4 times longer.*

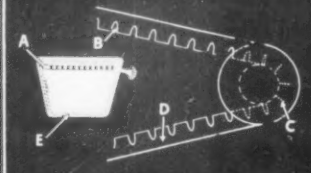
The superior performance of COMPASS-V-STEEL Belts is due to their revolutionary construction. They are sinewed with wiry, super-strong steel cables that safely carry far heavier loads than any previous belt. Heavy drives can be operated with fewer belts without loss of efficiency.

The G.T.M. will be glad to give you the full story on these miraculous new belts; how their economies can be applied to your operations. Just write: Goodyear, V-Belt Sales Dept., Akron 16, Ohio or Los Angeles 54, California.

GOODYEAR INDUSTRIAL RUBBER PRODUCTS

GTM -Specified COMPASS-V-STEEL BELT

for all types of V-drives



A Load-carrying section of endless high-tensile steel cable.

B Vents open between pulleys, dissipating heat.

C Vents compress rounding pulleys, giving continuous gripping surface.

D Highest quality rubber underbody.

E Sturdy, bias-laid fabric cover resists wear.

FOR HOSE, BELTING, MOLDED GOODS, PACKING AND TANK LINING built to the world's highest standard of quality, phone your nearest Goodyear Industrial Rubber Products Distributor.

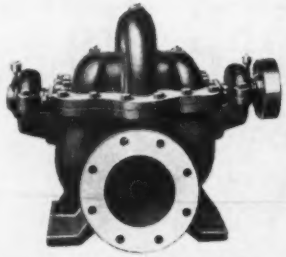
Compass—T.M. The Goodyear Tire & Rubber Company

GOODYEAR

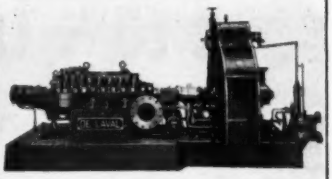
THE GREATEST NAME IN RUBBER

De Laval Centrifugal Pumps

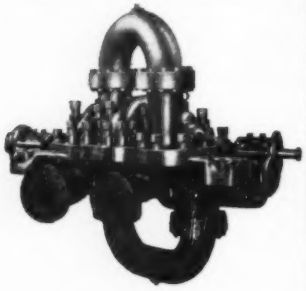
for all purposes



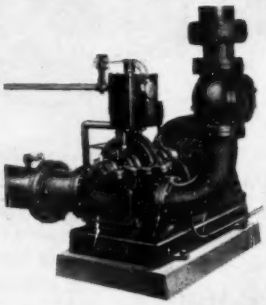
SINGLE STAGE, DOUBLE SUCTION PUMP made in capacities ranging from less than 100 gpm to upwards of 75,000 gpm.



1600 PSI BOILER FEED PUMP. Designed for trouble free, high pressure, high temperature service.



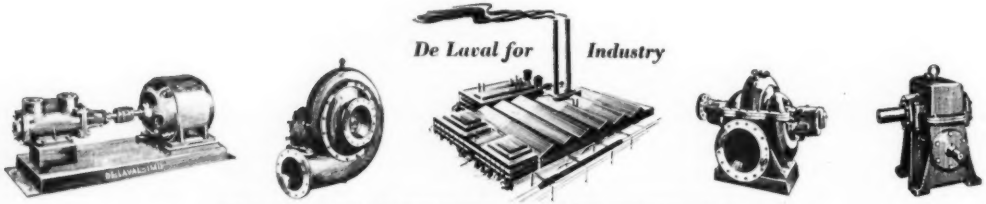
FOUR STAGE, OPPOSED IMPELLER PUMP. Built in two to six stages, for pressures up to 1000 psi.



SELF-PRIMING PUMPING SYSTEM. Automatically keeps pump primed at all times.

MIXED FLOW PUMPS. For handling large volumes at relatively low heads.

For over forty years De Laval has pioneered in the development of centrifugal pumps for almost every class of liquid-handling service. De Laval was the first to demonstrate the advantages of accessible, horizontally-split casings, high speeds, leak-minimizing Labyrinth Wearing Rings and other design features of undisputed value.



DE LAVAL STEAM TURBINE COMPANY, TRENTON 2, N. J.

GP-3

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS • CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS AND COMPRESSORS • IMO OIL PUMPS

POWER

N O WYNKOOP, *Publisher* **P W SWAIN**, *Editor*

L N ROWLEY, *Executive Editor*

Associate Editors: **F A ANNETT E W F FELLER J C McCABE B G A SKROTZKI**

Assistant Editors: **T DOMB J J O'CONNOR C F SANDERS**

Art Editor: **C F MARSCHALEK**

Washington: **GEORGE DOYING** *Atlanta:* **EARLE MAULDIN**

WORLD NEWS OFFICES: *London, Paris, Berlin, Moscow, Tokyo, Melbourne, Bombay, Rio de Janeiro, Buenos Aires*

MARCH 1949 VOLUME 93, NUMBER 3

A CROSS-INDEX OF SUBJECTS FOR THE MONTH

PLANT OPERATING METHODS, MAINTENANCE AND SAFETY
STEAM GENERATION, FUELS, FIRING AND COMBUSTION
TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
DIESELS, GAS ENGINES AND ACCESSORIES
AIR CONDITIONING AND REFRIGERATION
ELECTRICAL EQUIPMENT, ELEVATORS
PIPING, VALVES AND SPECIALTIES
TRANSMISSION, LUBRICATION
STEAM SERVICES, HEATING
INSTRUMENTS, CONTROLS
PUMPS, COMPRESSORS

FEATURE ARTICLES

Industrial cyclone furnaces serve 1250-psig boiler at Dow Chemical . . 72
Arc welding restores your turbine's runners economically 76
Clean turbines give top service 80
How to figure air friction in straight commercial ducts 82
How centrifugals perform when pumping viscous oils 85
Two ways to oxygen-free feedwater 88
Putting simple ac calculations to practical use 90
A steady service features film-plant power 94
Significance of chemical tests in lubricating-oil specifications 97
Old-timer resumes duty at new spot 100
Speaking of Power 102
Radio station WTAL goes diesel 103
We call it horsepower 106
100,000-kw generator takes a buggy ride 110
These operating practices keep mercury-arc rectifiers on the job 111
Here's a small boiler plant that doesn't need to make any apologies . 114
Cuts cooler defrosting time from 4 hours to 30 minutes 118
J P Pulliam Bayside Plant expands to catch up with rocketing demands 120
Dual-fuel engines cut costs 124

DEPARTMENTS

Electronics: 11—Filters and Voltage Doublers 126
Power engineer's notebook . . 130
New plant equipment 138
Technical briefs 150
George Edwards 156
Power-plant problems 134
Data sheet 146
Power news 154
Reader's literature 198A

VOLUME 93, NUMBER 3 • ABC • ABP •

COPYRIGHT 1949 by McGRAW-HILL PUBLISHING CO., INC. • ALL RIGHTS RESERVED

James H McGraw (1860-1948), Founder; James H McGraw Jr, President; Curtis W McGraw, Vice-President and Treasurer; Eugene Duffield, Executive Assistant for Publications; Nelson Bond, Director of Advertising; Joseph A Gerardi, Secretary; J E Blackburn Jr, Director of Circulation • DISTRICT MANAGERS: New York, W W Quaries; Philadelphia, C R Long; Cleveland, F B Godley, N O Wynkoop Jr; Chicago, C Boughton, J L King; Boston, J E Slater Jr; St. Louis, C Boughton • PUBLICATION OFFICE: 418 West 25th St, New York 1, N Y • EDITORIAL AND EXECUTIVE OFFICE, 330 W 42nd St, New York 18, N Y • Cable Address: "McGraw-Hill" New York • DISTRICT OFFICES: 520 N Michigan Ave, CHICAGO 11; 8 Post St, San Francisco; National Press Bldg, Washington 4; Architects Bldg, Philadelphia 3; 738-9 Oliver Bldg, Pittsburgh 22; 1510 Hanna Bldg, Cleveland 15; 2980 Penobscot Bldg, Detroit 26; Continental Bldg, St. Louis 8; 1427 Statler Bldg, Boston 16; 1011 Rhodes-Haverty Bldg, Atlanta 3; Pacific Finance Bldg, Los Angeles 14; Aldwych House, Aldwych London WC2 • POWER articles are indexed in both the Industrial Arts and the Engineering Index • POWER issues its own index annually; copies are available on request to the editorial office, 330 W 42nd St, New York 18.

up to 1/3 less space...
improved windings...
plate steel protected...
WESTINGHOUSE
NOW...
LUBRICATED
for LIFE

YOU CAN BE SURE.. IF IT'S

Westinghouse

—and NOW...

Lubricated for LIFE!

Now . . . for the first time . . . you can install electric motors, or motor-driven machines . . . and forget motor lubrication *for life!*

Westinghouse Life-Line . . . industry's amazing new, all-steel motor . . . now completely eliminates the biggest element in the maintenance of motors and motor-driven equipment . . . the need for periodic motor lubrication.

Eliminated, too, are two of the most frequent causes of motor burnouts and lost time . . . overgreasing and undergreasing of motors. Life-Line motors are equipped with sealed bearings, pre-lubricated for life with a more-than-ample supply of specially-treated lubricant.

Correct lubrication and long life are assured ... machine outages are reduced... motor drive problems are simplified, since motors can be located without need for constant accessibility.

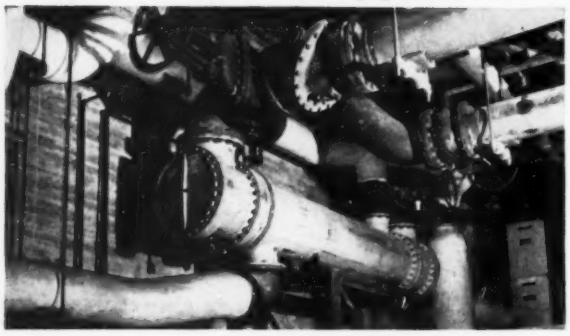
Added to Life-Line's outstanding advantages of plate-steel protection, improved windings and more compact size, *lifetime lubrication* is one more important reason for starting to convert, today, to Life-Line power. Standard ratings are available from stock—others on short delivery schedules. Ask your Westinghouse representative for price and delivery on your requirements, or write P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21495

Westinghouse

Life-Line

Motors

The modern approach in curbing



Corrosion

. . . in condensate returns
. . . in cold and tempered water lines
. . . in the vacuum priming system
. . . in condenser water lines
. . . in condensate tanks

BYERS WROUGHT IRON PIPE

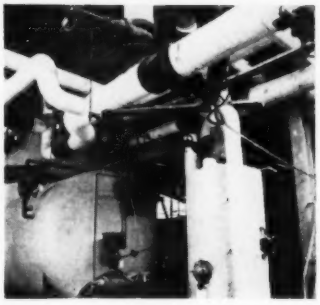
Here's a different kind of "cotton plant" than is usually meant by the term—a great new project of Springs Cotton Mills at Lancaster, S.C., which is said by the owners to be the most modern bleachery in the world. Robert and Company, Inc., architects and engineers, wrote all specifications with an eye to reducing maintenance to a minimum. To forestall corrosion attack in condensate returns, vacuum priming system, and condenser water lines in the power plant, and in condensate returns, tempered water lines and cold water lines in the bleachery, Byers Wrought Iron pipe was installed. Condensate storage tanks, built while the project was still in its early stages, are also wrought iron. Tanks were fabricated by R. D. Cole Manufacturing Company.

Because almost every mill and factory contains many miles of pipe line, *proven* durability should be the first requirement in every installation. Byers Wrought Iron pipe has been successfully used in dozens of varied plant services, and its ability to serve longer, at lower cost-per-year, has been convincingly demonstrated.

The reasons for wrought iron's unusual service qualities are found in its unique composition and structure, which are duplicated in no other material. Tiny fibers of glass-like silicate slag, threaded through the body of high-purity iron, halt and "detour" corrosive attack. The fibers also anchor the initial protective scale, which shields the underlying metal.

If you have any services in your present or projected plant where corrosion is a threat, you'll find it will pay to investigate wrought iron. Our bulletin, "Wrought Iron for Piping Systems", gives some helpful information. Ask for it.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Salt Lake City, Seattle, San Francisco. Export Division: New York, N. Y.



CORROSION COSTS YOU MORE THAN WROUGHT IRON

BYERS
GENUINE WROUGHT IRON
TUBULAR AND HOT ROLLED PRODUCTS
ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

POWER

PHILIP W SWAIN, EDITOR • MARCH 1949 • ESTABLISHED IN 1882

Prosperity Ahead

POWER ENGINEERS—like all their neighbors—want to know what's ahead for business. Are the signs good or bad?

Speaking for our economy as a whole, and not for any particular branch, we answer "Business looks good for 1949 and maybe for some years beyond that." This means a very high level this year by any reasonable standard of well-being and prosperity, but does not imply that the record business of 1948 will be maintained much longer.

Economists agree that times are good when the heavy industries prosper, so the McGraw-Hill Department of Economics sought the key to the future in the plans of the manufacturing industries, mining, transportation and utilities to rebuild or extend their productive facilities—plants and equipment.

According to the McGraw-Hill survey, the total capital expenditures in these industries was 14.8 billion dollars in 1948. Present actual plans call for spending 14.1 billion dollars in 1949, 12.0 in 1950, 10.5 in 1951, 9.6 in 1952, and 9 in 1953.

Note that the 1949 total is only 5% less than 1948, and remember that the plans for later years are increasingly tentative and more likely to be increased as the future unrolls.

While greatly concerned with the general picture, power engineers will be interested to learn that the electric utility executives plan to increase the yearly investment in facilities from 1.8 billion dollars in 1948 to 2.0 billion in 1949. Present tentative figures are 1.8 in 1950 and 1.6 each in 1951, 1952 and 1953. All the sums listed are investment. No operating costs are included.

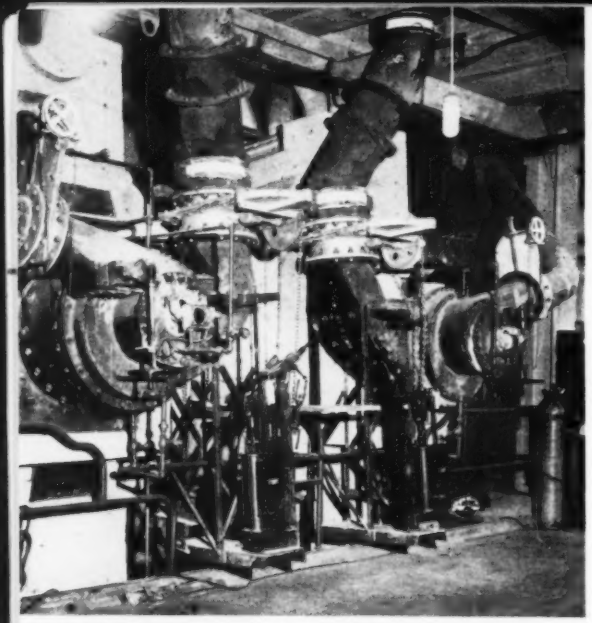
The survey shows that the manufacturing industries are catching up on their expansion programs and that the money spent for greater capacity will fall off considerably. Yet the overall investment program will hold up well.

This is explained by the swing from *enlarged* facilities to *replacement* and *modernization*. In the 1949-1953 period three-fourths of the total capital expenditures will be for replacement and modernization of existing buildings and equipment.

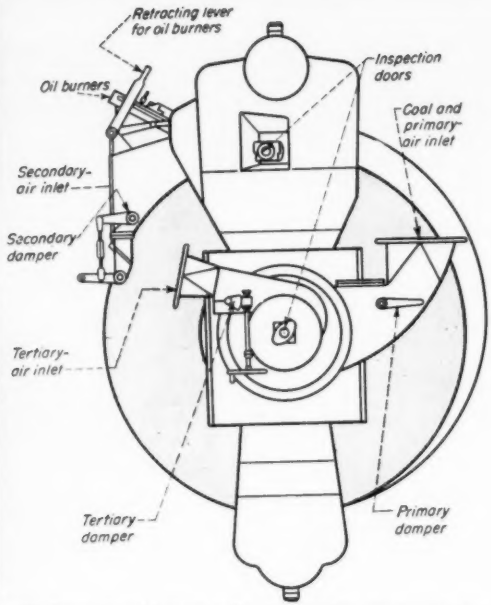
Will this modernization money dry up in a few years? There is no good reason to expect it. The survey shows that an average replacement life of 17 to 20 years would maintain the indicated investment level indefinitely.

Of course these present actual plans of hard-headed industrial leaders could be changed by the force of political events.

We quote from the report: "American industry is prepared with a program of expenditures for new industrial plant and equipment which can increase the national security, raise the American standard of living, and make a key contribution to a continuation of high-level prosperity. But whether or not the national policy makers in Washington or elsewhere are prepared to let American industry have that opportunity remains to be determined. The policy makers have what well may be a decisive role still to perform."



1 Two cyclones, of 8-ft internal diameter, complete combustion of enough coal to generate 400,000 lb steam per hour



2 Front view of furnace in Fig. 1. Secondary air stream enters tangentially at 20,000 to 30,000 ft per min velocity

Pioneer Industrial Cyclone Furnaces For Dow Chemical's 1250-Psig Boiler

Two cylindrical furnaces releasing 545,000 Btu per cu ft per hr in high-velocity vortex supply heat to generate 400,000 lb steam per hr at 1250 psig, 900 F in unit at Midland, Mich.

► Dow Chemical Company, long associated with advanced techniques of steam and power generation, is pioneering the new "cyclone" type of boiler furnace in the industrial power field. The only commercial predecessors of the Dow units are those installed at the Calumet station in 1945 by Commonwealth Edison Co.

Two of these Babcock & Wilcox horizontal, cylindrical, cyclone furnaces, of 8-ft diameter inside and 8-ft effective length, serve Dow's new No. 13 steam-generating unit, which went on the line in February in the West Side power plant at the main chemical works of Dow Chemical in Midland, Mich. This big boiler is rated 400,000 lb of steam per hour at 1250 psig and 900 F.

Although Dow's boiler, like that at Calumet, has conventional watercooled primary and secondary furnaces, these serve merely as spaces where gaseous combustion products may radiate heat to the enclosing waterwalls, and also keep the slag molten in the main slag pool. Actual combustion of both the solid coal and of combustible gases is said to be practically complete when the gases leave the cyclone furnaces.

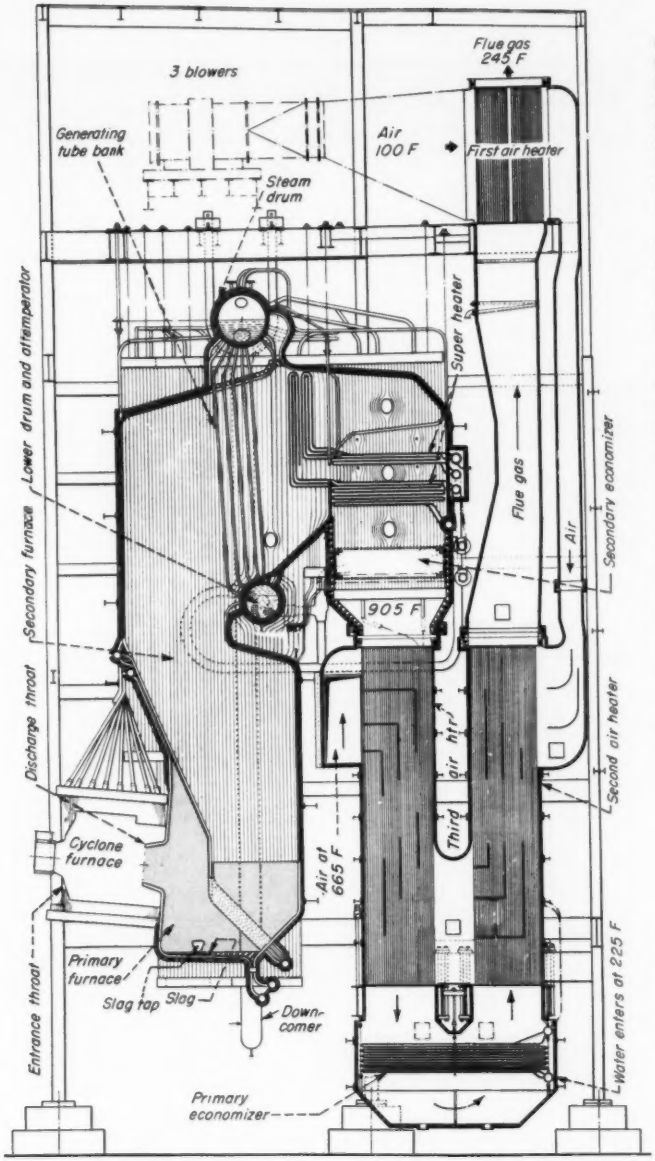
Extreme Combustion Rates. Figuring only the combined combustion volume of the two cyclones, the full-load combustion rate attains the spectacular value of 545,000 Btu per cu ft per hr. But, if the primary and secondary furnace volumes also are arbitrarily included, the combined heat release for all furnaces (two cyclones plus primary and secondary) is reduced to the more conventional figure of 32,800 Btu per cu ft.

The cyclone furnaces at Dow Chemical are almost identical with those that have undergone extended commercial trial at Calumet with a variety of coals. Certain steam-generator features are also similar in the two plants—notably the secondary furnaces and the associated slag screens and slag pools.

Entire Furnace Pressurized. On the other hand, the Dow unit differs radically from the Calumet boiler in the pressurizing of the entire unit and the omission of the induced-draft fan. High-pressure blowers of advanced design handle the pressure drop through the entire air and gas circuit from blowers to stack.

The amazingly high heat-release rate is not only made possible by the cyclone furnace, but is, in fact, essential to the successful operation of this radically new type of furnace.

How Cyclone Works. The cyclone



3 Cross section of new steam generator. Indicated air and gas temperatures are predicted performance at 350,000 lb per hr steam load and 10% excess air, when burning coal of 3% moisture, 22.3% volatile, 67.3% fixed carbon, 7.6% ash

furnace, Fig. 1 and 2, is a cylindrical combustion chamber of 8-ft internal diameter. The crushed (not pulverized) coal is carried in a high-velocity stream of preheated high-pressure primary air (15 to 20% of total combustion air). This is introduced on a tangent through the cylindrical primary burner at one end of the cyclone furnace.

Centrifugal forces in the rapidly spiraling mass throw out the relatively coarse coal particles and embed them in the thin layer of molten slag that coats the inside of the furnace. There the solid particles are rapidly burned by the scrubbing action of the high-velocity secondary air, which is admitted tangentially along part of the furnace length. This secondary air is 75 to 80% of the total combustion air. The finer coal particles burn in suspension.

Molten slag from the combustion is continuously trapped to the slag pool under the primary furnace from a hole in the end of the cyclone furnace. The cyclone in the Dow installation inclines 5 deg forward to assist slag flow.

The gaseous combustion products leave the cyclone furnace through a central reentrant discharge throat, designed to catch and retain any solid particles that have not been fully reduced to molten slag.

Coal Conditioning. In the direct-fired system used in this installation (as distinct from the bin system) raw coal is fed in controlled amount by gravity from the bunker to the crusher. With it flows the preheated pressurized primary air. Both air and coal pass through the crusher (or coal "conditioner") and are discharged tangentially into the cyclone furnace through the primary burner.

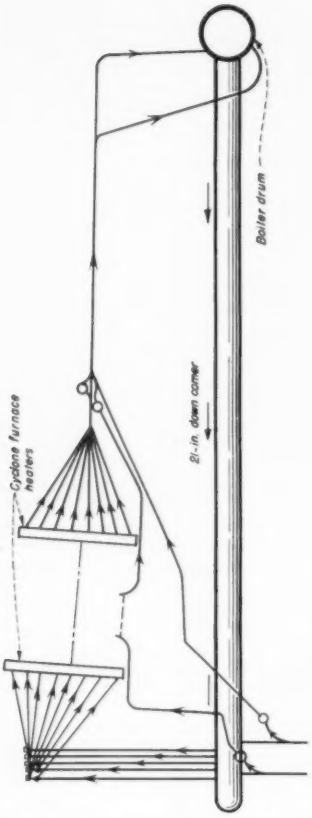
The makers of the equipment suggest that the size distribution of the coal leaving the conditioner should be about as follows:

Screen No.	*Percent Passing*
4	95
8	85
14	70
28	50
48	30
100	20
200	10

Only 10% of the material is fine enough (200 mesh) to be called "pulverized coal." Average particle size, however, is considerably less than in normal coal crushing. Hence the expression "coal conditioning" in this case.

Cyclone Details. The cyclone furnace, Fig. 1 and 2, is formed by closely spaced pairs of watercooled boiler tubes, arranged to form a cylinder. These expand into bottom and top headers connected into the boiler circulating system. Each individual tube is a semicircle, conducting water from the lower cyclone-furnace header to the upper.

The tube sides forming the inside surface of the cyclone are studded and covered with plastic chrome ore as a base for slag adhesion. The tubes forming the conical entrance of the cyclone furnace next to the primary burner are protected from erosion by smooth cast-iron blocks. The reentrant discharge throat is formed by, and is part of, the



4 Semicircular loops of studded tubes, chrome-ore covered, form inner wall of cyclone furnace. Here's the cooling circuit, part of regular boiler circuit

EXPECTED PERFORMANCE DATA ON CYCLONE FURNACES OF DOW CHEMICAL CO., MIDLAND, MICH.

Steam, 1000 lb per hr			280	350	400
Excess air, percent			10	10	10
Coal, 1000 lb per hr			27.6	34.6	39.6
Flue gas entering stack, F			233	245	256
Water entering first economizer, F			225	225	225
Air leaving last air heater, F			591	665	713
Air resistance and draft losses, in. water:					
Air circuit			36.3	39.9	43.0
Gas circuit			4.8	7.5	9.9
Total, fan to stack			41.1	47.4	52.9
Heat loss, percent:					
Dry gas			3.2	3.5	3.8
All moisture sources			3.6	3.6	3.6
Unburned combustible			0.3	0.3	0.3
Radiation			0.5	0.4	0.4
Unaccounted for			1.5	1.5	1.5
Total			9.1	9.3	9.6
Unit efficiency, percent			90.9	90.7	90.4
Coal analysis:	Moisture	2.99			
	Volatile	22.20			
	Fixed C	67.26			
	Ash	7.55			
	Total	100.00			

Ash-softening temperature (in a reducing atmosphere), 2300 F

front-wall tubes of the primary furnace.

The primary burner, centrally located at the inlet end of the cyclone furnace, imparts a whirling motion to the crushed coal and primary-air mixture. This distributes the coal over the slag-covered surface of the cylindrical furnace. Quantity of the air in the coal-and-air stream entering the burner is regulated by a cantilever damper, which maintains a high centrifugal velocity at all loads.

The burner's inner surface is lined with a removable wearing plate that requires periodic replacement. A cooling jacket supplied with service water surrounds the primary burner.

The secondary air (75 to 80% of total air) is introduced tangentially to the cyclone furnace with the same direction of rotation as the primary air and coal. At high velocity the gas and suspended particles spiral toward the discharge end of the cyclone where the gas reverses direction and throws out most of the remaining solid particles before passing through the discharge throat.

The quantity and distribution of secondary air are regulated by cantilever dampers.

A small flow of tertiary air, 3 to 8% of the total air, is admitted at the center of the primary burner to prevent recirculation of fine coal in the primary burner and to insure delivery of enough air to burn any fine dust that may hang near the axis of the burner vortex.

The tertiary air, like the primary and secondary, is introduced tangentially to a cylindrical housing to give it the same direction of rotation as in the primary burner. Another cantilever damper regulates this tertiary air.

Low-Rate Operation. To insure proper combustion and free-flowing slag, the Dow engineers plan not to operate either cyclone furnace below its half-load point. But by cutting out one cyclone furnace the unit can easily be operated down to one-quarter full load.

Draft Requirement. Since steam loads in this chemical plant are exceptionally uniform this available range (quarter load to full load) will be more than ample. Draft requirements differ radically from those of conventional boilers. Operating without any induced-draft fan, this new unit at Dow Chemical will be served by three (one a standby) Joy high-efficiency axial-flow variable-pitch blowers, each capable of delivering 47,500 cfm at a total head of 77 in. of water. The blowers are straight-line-flow units with air flowing in from first to second stage in a shell around the dc 800-hp motor.

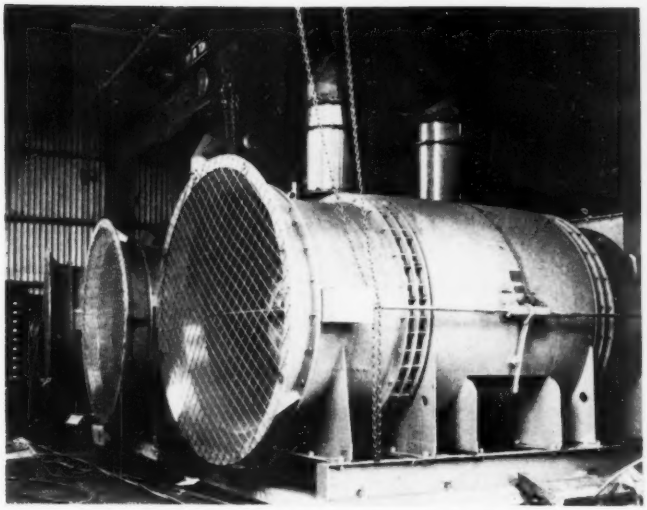
Unit Is Pressure Sealed. Because the entire boiler unit is under substantial gas pressure, it is elaborately sealed against gas leakage through walls or access openings. Primary leakage barrier is a 10-gage steel sheet welded to the outside of the tubes and, therefore, operating at approximately tube temperature. Insulation is outside of this sheet.

Actual full-load gas pressure will range from 10-in. water in the primary furnace to zero at the stack entrance.

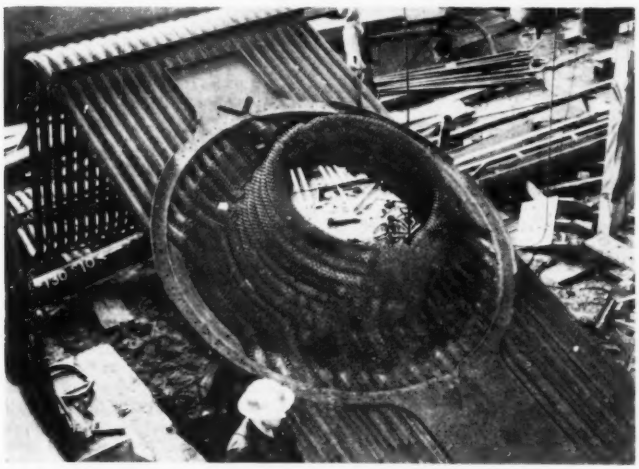
Setting doors are securely locked against accidental opening while furnace is in operation.

Small access doors, that may have to be opened under furnace pressure, interlock with 60-psig air jets which blow back the flames when doors are opened. Removal of most of the ash as slag in the cyclone furnaces greatly reduces the need to get at the heating surfaces for cleaning and inspection.

Steam-Generating Units. Fig. 3 shows the general arrangement of the entire unit, including 2-stage economizer, 3-



5 Each of three blowers (one standby) requires 800-hp, 1750-rpm motor. The two-stage axial-flow blower has adjustable blades, 47,500 cfm at 77-in. water



6 Stud tubes that form the discharge throat of the cyclone furnace (see Fig. 3) are part of the main circulation in the front walls of the primary furnace

stage air heater and 2-stage superheater. Indicated temperatures and air pressures represent expected performance, since actual operating data on the Dow installation are not yet available.

The boiler, or evaporating sections, consists of the convection-tube bank (connecting upper and lower drums), watercooled primary and secondary furnaces, primary-furnace reflecting arch, screen tubes, furnace doors, convection-pass walls. All of these discharge into the 60-in. diameter steam drum and are fed from this through two 21-in. diameter downcomers.

These same downcomers feed the headers supplying the lower headers of the waterwalls and the lower header of the cyclone furnace. Water passes rapidly up through the semicircular tubes surrounding the cyclone furnace to the top header and then into front-wall tubes of the secondary furnace.

Superheat Control. Superheat temperature is held at 900 F by "attemperating" a controlled fraction of the steam flow from the primary to the secondary superheater. The attemperator is in the lower drum.

Leaving the nozzle of the cyclone furnace, the gaseous combustion products entering the primary furnace are deflected downward at the reflecting arch, depositing remaining ash particles in the slag pool. They then pass through the slag screen, secondary furnace, convection steam-generating surface, primary and secondary superheater, second economizer, third air heater, first economizer, second air heater, first air heater.

Note that the high-pressure blowers on top of the unit deliver directly to the first air heater, and that the air heaters, economizer casing, and all duct work up to the cantilever air dampers at the cyclone furnace, must carry from 40 to 60 in. of water pressure.

Slag Removal. Slag drained from the delivery end of the forward-tilted (5 deg) cyclone furnace flows first to the slag pool at the base of the primary furnace, and from this is tapped off to a hydraulic ash-removal system water-sealed against the existing gas pressure.

Air at 30,000 Fpm. Primary and secondary air enter the cyclone furnace with tangential velocities of 20,000 to 30,000 ft per min. With its high temperature, and extreme turbulence, this type of furnace permits operation with much less than the typical 25% excess air. In fact, excess air as low as 15 to 8% is not only economical with this furnace, but desirable for success.

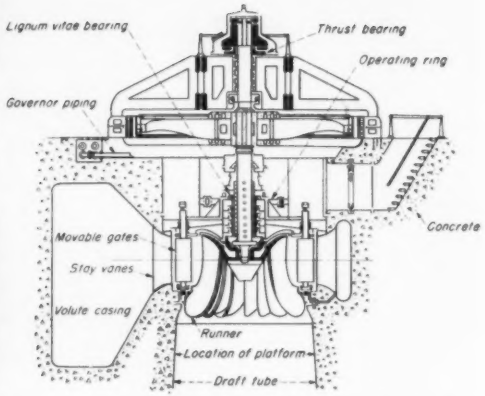
Excess Air 10%. Pending actual experience with the present Dow installation, its operators plan to carry 10% excess air corresponding to about 2% oxygen in the flow gases. This excess will be measured directly by automatic oxygen determination. With low excess air the oxygen-excess air relationship is practically constant at 5% excess air for each 1% of oxygen. This holds regardless of coal composition.

A study of the anticipated heat balance in the table on page 74 shows how a low excess air of 10%, combined with a final flue temperature of only 233 F to 256 F, reduces the dry-flue gas loss to less than 4%.

POWER acknowledges the cooperation of the engineers of Dow Chemical Co and Babcock & Wilcox Co in the inspection of this pioneer installation and gathering and checking the data.

Two similar steam-generating units with cyclone furnaces are being installed in the New Southside power plant of Dow Chemical at Midland. This new installation will feed the conditioned coal from bin storage.

1 Here's an idea of the size of the runner blades themselves: a 50,000-hp 120-ft head 45-ton turbine runner



2 Fully assembled view of a typical hydro-turbine unit shows how runner-replacements involve a considerable expense

Arc Welding Restores Your Turbine's

Cavitated water-turbine runners represent a major maintenance problem for hydroelectric stations. But to repair them economically is a real problem. L McWilliams*, Shawinigan Water & Power Co, outlines a system set up by his company to arc-weld runner blades in position without the loss of a kilowatt-hour

► WATER-TURBINE RUNNERS experience severe cavitation and their repair usually means involved load-scheduling, costly maintenance. But the Shawinigan Water & Power Co, Shawinigan Falls, Quebec, Canada, successfully restored to their original contour and efficiency the runners of a 45,000-hp Francis reaction turbine by arc welding, without the loss of a single kwhr output.

Pitting on this particular turbine had progressed to the point where holes had formed in some of the buckets, Fig. 5. And the only reason they had been allowed to develop was because system load stayed so high the turbine could not be released for needed maintenance. This called for a highly specialized repair program, confined to available weekends when power demands and river flow permitted maintenance.

A number of methods came up for consideration. One proposal called for dismantling the unit, removing the defective runner, and installing an old cast-iron runner that was available. The defective runner could then be repaired and reinstalled at a later date.

One other power company reported a high degree of success in changing turbine runners quickly. This company trained a maintenance team for this changeover job and reduced the time required to change a runner to 40 hr.

We investigated their methods fully. An organized team could very definitely reduce the over-all time to dismantle and reassemble the unit. But there was one deciding factor that steered our thinking against this method. That factor was the way the runner was secured to the shaft.

The turbine of Shawinigan's No. 6 unit has a tapered shaft with the runner secured by two keyways and locked. The runners that had been changed in 40 hr bolt to a flange set on the shaft.

Best estimates indicated that each change would require five days, making ten days in all. These estimates took into account the lack of a trained "runner-changing" team and the fairly difficult runner keying arrangement.

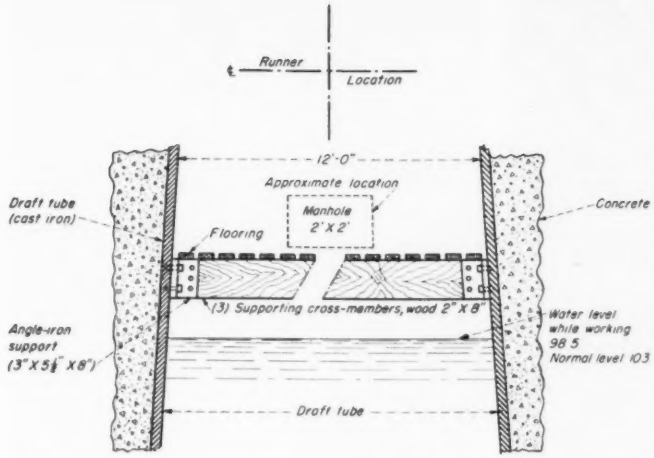
Furthermore, the 10-day outage meant the unit would be out of service 84 hrs during peak periods at each change—a total loss in power of 6,200,000 kwhr. In addition there was a strong possibility that unforeseen delays could develop in removing the runner, which had been in place 12 years. Such a situation would add to the power loss.

A second method for carrying out the repair proposed (1) making and fitting tailrace stop logs into the discharge passage (2) unwatering the discharge chamber (3) proceeding with the runner repairs.

This highly practical approach would, however, prove expensive and mean a loss in output for the entire repair period. In 1945 our No. 8 unit at Shawinigan Falls Generating Station had been repaired by this method and we knew the expense and time involved.

*L. McWilliams is assistant power-house superintendent, Shawinigan Water & Power Co, Shawinigan Falls, P.Q., Canada.

Welding data and illustrations are from a study submitted to The James F Lincoln Arc Welding Foundation in its recent $200,000 Design-for-Progress Award Program, for reports, advances and improvements made by the application of arc welding in design, fabrication, construction and maintenance.



3 Emergency raft constructed in the draft tube of the unit under repair permitted arc welders to fill in position the cavitated turbine runner blades

Runners Economically

In that case all the outlay had been warranted because the concrete walls and floor of the discharge chamber needed extensive repairs.

Finally the following method evolved: Lower the tailrace level enough to permit entry into the turbine below the runner, through a 2x2-ft manhole in the draft tube, and repair the runner while in position by arc welding.

Once a decision was reached we undertook certain preparatory steps for designing a platform from which to work and for setting up the necessary safety precautions.

The Platform. Flow of the St. Maurice River at Shawinigan Falls can be controlled within limits. So lowering the tailrace level during the weekend off-peak period was a simple matter. But this period lasted only from Saturday noon to Sunday midnight. Any platform from which the work could be carried out had to be one that could be quickly put together and knocked down.

For the first weekend the normal tailrace elevation of 103 ft was lowered to 98.5 ft, a point about 2 ft below the lower edge of the 2-ft manhole, Fig. 3. (Later the level was dropped to only 1 ft below since that point (1) gave sufficient working clearance (2) reduced the time required to restore normal river flow.) And work began on constructing a raft and installing supports in the draft tube for the platform. Timber pieces, 8 in. by 8 in. by 8 ft, made up the raft. They were pushed through the manhole and nailed together with suitable crosspieces.

From this raft workmen drilled and tapped holes in the cast-iron draft tube wall to fit in sections of $\frac{3}{8}$-in. angle iron. These angle-iron brackets, six in all, 3x5½x8 in., bolted to the draft tube wall and left in place, made up the supports for the working platform.

Three sturdy 2x8-in. planks or beams fitted on edge, Fig. 3, and bolted in place, formed the working platform supports. Actual flooring for the platform was 1½-in. planking fitted on top of these 2x8-in. beams inside the circle of the draft tube. All planks and beams were marked to make placing them easy each working period.

This system of marking boards paid off. After a few weekends the men could completely rig or remove the platform in 45 minutes. Since available time amounted to only 31 hr each weekend, and toward the end of the repairs to as little as 12 hr, all time saved in platform rigging was most helpful.

Along with this effort to conserve time a special procedure was worked up to get the first beam or cross support in place to within 1 ft without the help of a raft despite the fact that the draft tube was full of water. A 2x10-in. plank was projected into the draft tube from the manhole and blocked at its outer end. A workman crawled out on this plank, set the first beam in place and bolted it fast to the angle brackets. A safety harness fitted to the workman had a life line attached just in case.

Safety Considerations. This same careful provision for job safety carried throughout. From the first safety requirement for "clearance" and tailrace elevation to worker comfort every precaution was taken. The company's *Operating Code and Safety Rules* governed all phases.

For instance, stop gates were placed in front of the unit headgate in keeping with company safety rules while work was under way.

The servomotor that operates the turbine-gate vanes was locked in position to give a 5/10 gate opening. This opening allowed the welders to work between the vanes so they could reach all the cavitated areas on the runner.

Because a fire hazard existed while burning and welding operations went on above a wooden platform, we kept on hand a small fire hose and a number of portable CO_2 fire extinguishers. Light sheet-metal pans placed directly beneath the work caught any molten metal that fell during burning out. Two small fires did get started but the extinguishers on hand put them out.

Each welder worked in a full-length leather coverall and strong leather gauntlets to guard against burns. Asbestos-sheeting barriers separated each welder from his neighbor.

A manhole cover, removed from the top of the scroll case, and opened turbine vanes gave enough air circulation to sweep away all gas released in burning and welding. When the weather grew colder, heaters gave added comfort to the welders and seemed to speed up normal air circulation.

The runner itself acted as ground for the welding machines. Studs of ½-in. dia welded at convenient spots on the runner served as connecting terminals for the welding-machine ground lugs.

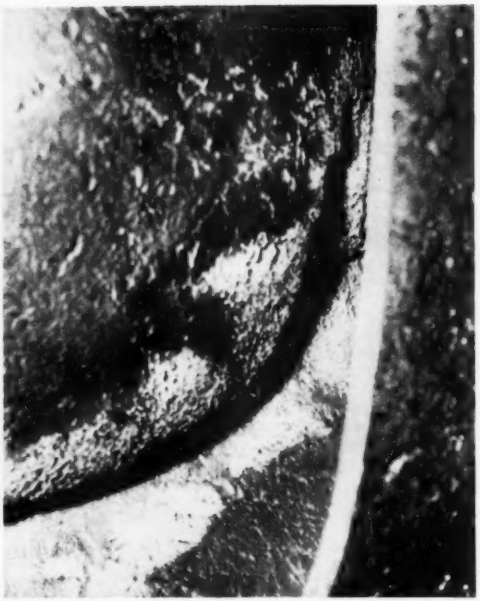
A properly fused ac supply circuit fed each machine with control switches mounted as close to work as possible. Temporary 110-v lines provided lighting at first. Then a 2-kw 2200/120-v transformer, rewound for 220/110/32 v, took over and supplied 32-v lamps.

Repair Steps. First stage of repair consisted of burning out by carbon arc the spongelike metal formed by cavitation, Figs. 4, 5, 6, 7, and then chipping clean to get down to solid metal.

Some of the cavitated area measured from 3 to 4 ft. long, 12 to 15 in. wide, and 2 to 2½ in. deep. Where cavita-

CAVITATION TOOK DIFFERENT FORMS

4 Repair of the cavitated regions proceeded in definite stages; the first involved burning out sponge-like metal



5 Some cavitated areas such as the above measured from 3 to 4 ft long, 12 to 15 in. wide, and from 2 to 2½ in. deep

tion developed at the extreme discharge edge of the buckets entire sections were cut away with the torch. The blacksmith formed steel plates of the proper shape and thickness to weld into place. Most pitting, though, showed up on the back or discharge side of the runner buckets, well back toward the band and crown where it is difficult to reach, Fig. 4, 5.

It took the first two working periods to burn out the cavitated area. A ½-in. carbon rod with 400 amp did the job. Because of tight space conditions, chipping hammers proved hard to handle so considerable burning action was used, followed up by wire brushing.

Since the unit had to return to service before midnight each Sunday considerable care was exercised that not too much of the area of blades or buckets on one side of the runner was cut away. Without this precaution an unbalance could have developed.

Burning and welding operations required eight welders in two shifts of four men. And because of the small space between runner buckets two on each shift were fairly small-built men so they could squeeze into the 9-in. space. After four of the 16 runner buckets were thoroughly burned out and cleaned two of the welders started filling the cavities while the other two on the shift continued burning out.

Filling in Cavities. The second stage of repairs—filling in the cavities—consumed considerable time. Almost a ton, by and large, of mild-steel rod, Willson No. 98, 3/16 in., was laid in using reversed polarity and a current of 150 amp. Willson No. 107 and Fleetweld No. 5 rods proved suitable for this work.

A continual lookout for cracks, as telltale signs of undue stress from welding heat, revealed no difficulties from this source. In fact, warpage or cracks have never developed on any steel runner repaired by arc welding in the various Shawinigan Water & Power Co plants.

Third repair stage began when runner buckets had been restored to their original contour. Grinding and cleaning of the mild-steel surface prepared it for a stainless-steel overlay.

Just as soon as a number of buckets were judged clean enough to "take" the stainless steel, the welders started laying beads. Each time they tried to start at the bottom and work upwards, especially when working in a vertical plane. Each pass was "peened" to remove slag and, we hoped, in some small way relieve internal stresses. Stresses, though, from welding on the surface of a 12 ft 6 in. dia runner, weighing 35 tons and standing 6 ft 6⅛ in., probably amount to very little.

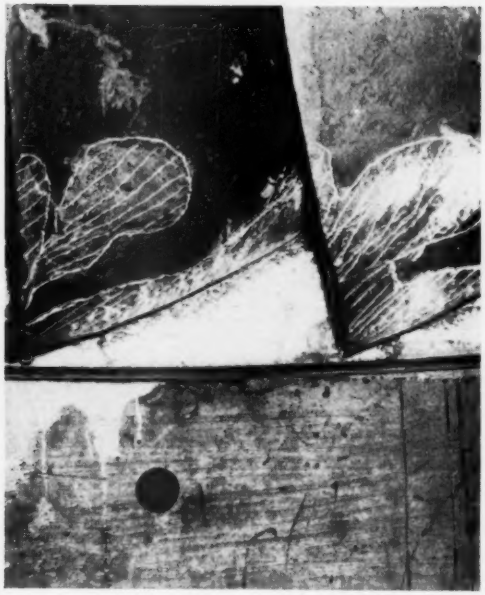
Grinding and polishing the stainless steel to as high a polish as possible made up the fifth and final repair stage. All experience with pitted waterwheels tends to substantiate the claim that a smooth surface affords less opportunity for cavitation than a rough surface.

Air-driven and electrically driven grinding tools of the straight spindle and surface-grinding type served in this phase. Both types employed Norton resinoid-bond grinding wheels. But each employed its own special designs.

Costs. How much did such an extensive repair cost? Before you can talk costs (see table) you must bear in mind cavitation was so advanced it meant extensive repairs or a new runner to restore the turbine unit to original efficiency. And by estimate a new runner would cost $30,000 before installation.

In addition, the repair job conducted by the method just described involves all overtime labor charges. Yet the additional labor charges of around $2000 represent only a fraction of the revenue loss from approximately 5 million kwhr.

6 Once runner buckets were restored to the original contour they were ground and cleaned for a stainless-steel overlay



7 Stainless-steel overlay, Fig. 6, was ground and buffed to as high a polish as possible to resist future cavitation

which would result from shutdown.

The company's safety rule, calling for stop gates to be placed in front of the headgates when a turbine is "cleared" for work, imposed extra labor costs for the installation and removal of stop logs, once each weekend, or 26 times in all.

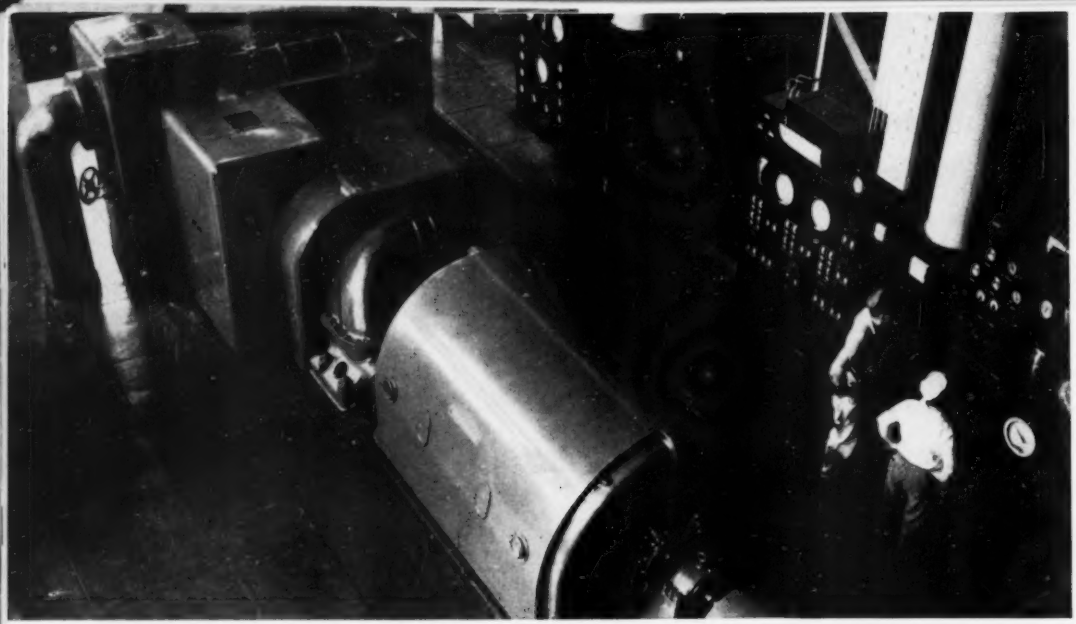
The table shows total costs and breakdown by major divisions. Estimates on the other most practical method, that of unwatering the discharge chamber and proceeding with the repair to completion, indicate an unfavorable comparison. No. 8 unit at Shawinigan Falls was repaired by this method in 1945. It took 52 days and the loss in output, while terrific, cannot all be charged to the repair job. Further, the inroads from cavitation were not so severe. Only 273 lb of mild steel and 170 lb of stainless were needed. Yet costs ran:

Labor	$783.96
272 lb mild steel	31.35
170 lb stainless-steel rod	152.27
Miscellaneous	137.31
Total	$1104.89

Add to this the cost of fabricating, installing and removing stop logs and total costs approach 30% of those for the job just described on No. 6 unit.

COST OF REPAIRING TURBINE RUNNERS

Scaffolding and Preparation	
Labor (installation and removal of stop logs)	$ 567.17
Labor (making, installing and removing platform)	504.00
Miscellaneous (materials, etc)	170.90
	$1242.07
Welding—"filling in" with mild steel	
Labor	$2953.53
1890 lb mild-steel welding rod	182.07
Miscellaneous	199.09
	$3334.69
Laying stainless steel	
Labor	$ 591.45
645 lb chromed welding rod	593.34
Miscellaneous	7.20
	$1191.99
Grinding and finishing	
Labor	$1046.74
15 grinding wheels	69.17
Miscellaneous	30.34
	$1146.25
Total	$6915.00



SCALE FORMATION on blades cuts down turbine efficiency but you can remove scale even under load-carrying conditions

Clean Turbines Give Top Service

Regular turbine-washing program enables turbines to carry peak load indefinitely. Frank Peterson, Standard Oil, tells how to set one up

► UNDER NORMAL OPERATION turbine blades can be expected to foul up. The nature of the deposits that build up on the blades and cut down on the efficiency varies with the chemicals in the carryover. Their removal is an operating must.

At the Bayway Refinery, Standard Oil Co of N. J., a practice of regularly scheduled turbine-washing has been carried out for years. This washing takes place while the turbine is running and carrying load. Its effectiveness has been demonstrated in many plants.

Let's look at the scale-removal problem itself. Scale formation on the blades themselves can be removed by: (1) letting enough solid water carry through the turbine to dissolve the chemical bonds holding deposits on the blades, (2) cooling the blades enough to set up a differential in contraction that cracks the scale off, (3) directing enough water drops against the blade surface to wear off the scale mechanically.

While water seems to provide the answer to the problem, its correct application requires proper connections first and a well-organized washing procedure. Without these precautions turbine-washing can cause troubles or even damage to turbine blading. Here are tips picked from a successful system developed over a period of years.

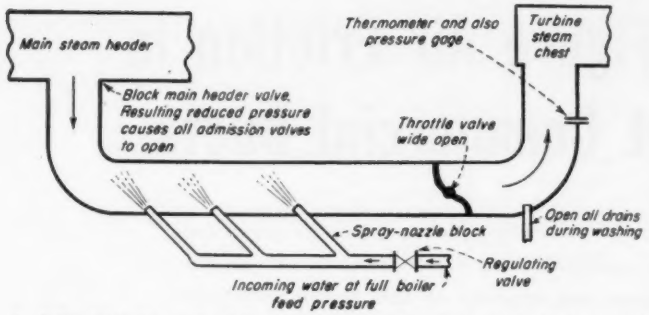
Getting Started. 1. At a point at least fifty feet ahead of the turbine throttle valve put in a connection from the boiler feed line to the main steam line, Fig. 1. Terminate the connection in a nozzle arranged so the incoming water breaks up into a spray directed against the steam flow in the main. Number and size of holes in the spray nozzles, Fig. 2, should be so regulated that, when the turbine carries a load such as specified below, enough water enters at full boiler-feed pressure to lower steam temperature, Fig. 4, at the turbine inlet to ten degrees above saturation (corresponding to pressure at point where temperature is read). Turbine load for washing should be about quarter load on machines up to 20,000-kw rating. Condensing units can carry higher loads up to the limit set by the amount of water that can be introduced through the spray nozzles.

2. Locate a thermometer and pressure gage in the steam line between valve group and turbine cylinder. This gives a check on how thoroughly steam and water mix after passing through the strainer, throttle valve and governing valve group. With industrial turbines, where steam chest mounts on the cover, arrange thermometer and pressure gage in the connection between throttle and steam chest. Select a recording thermometer of quick response.

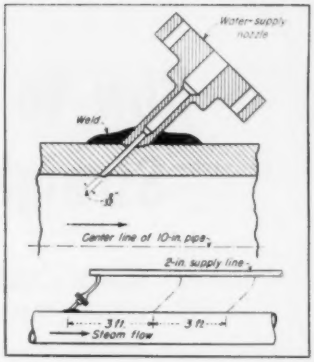
3. Make sure all water pockets (such as form in steam chest, main throttle valve, dummy leak-off spaces and bleeder zones) can be drained fully. Open all these drains during washing.

4. End-tightened turbines, or those with axial-clearance dummies, ordinarily have an adjustable thrust bearing. Before washing, move thrust bearing to "start-and-stop" position. This increases clearance for blades or dummies.

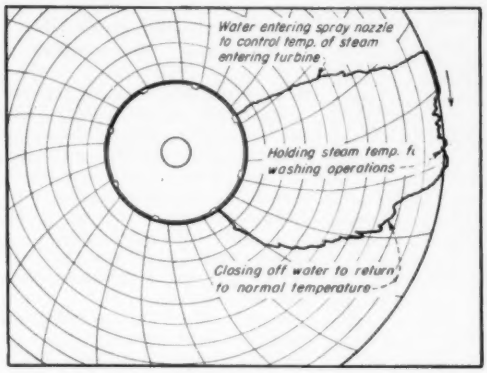
Washing Procedure. 1. Establish


Main steam header
Thermometer and also pressure gage
Turbine steam chest
Block main header valve. Resulting reduced pressure causes all admission valves to open
Throttle valve wide open
Open all drains during washing
Spray-nozzle block
Regulating valve
Incoming water at full boiler feed pressure

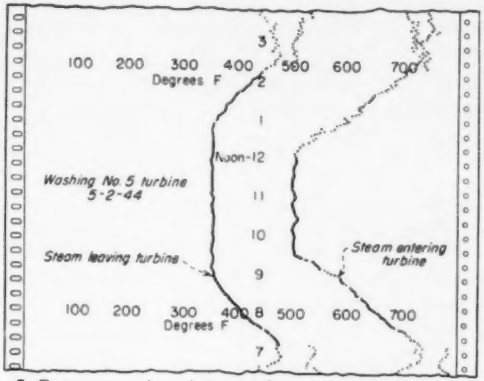
1 Boiler feedwater under full pressure passes through a nozzle block spotted ahead of the throttle and discharges as a spray against the incoming steam



2 Nozzle tip and design varies widely. Here is one suggestion that works


Water entering spray nozzle to control temp. of steam entering turbine
Holding steam temp. fo washing operations
Closing off water to return to normal temperature

3 Water-flow chart on feedwater supply line clocks washing time and indicates quantity of water for this purpose



4 Temperature drop during washing is important to know. Above chart on incoming and outgoing steam gives this data

quarter load on the turbine. Enough steam flows through the turbine at this load to carry all added water through the machine without any of it collecting in cavities at the bleeder zone or similar places. The objection to carrying higher loads is that it takes too much water to bring down the temperature.

2. Next open all valves admitting steam to the first element of the turbine. A straight reaction type, or a turbine with a single group of nozzles at the first impulse wheel, needs no special adjustment to produce full valve opening. If the turbine has an impulse wheel with several groups of nozzles all valves to the first wheel must be opened. This gives a uniform cooling of nozzle chambers.

Where several valves must be opened to carry a specified load, close throttle valve gradually. Adjust speed changer at the same time, until all steam admission valves to the first wheel are open and the specified turbine load is still being carried. This adjustment means a considerable drop over the governing valves admitting steam to the first wheel. Under these conditions close off any valves bypassing the first element.

3. Listen for rubs during washing, particularly when water is being admitted. Note any increase in vibration. Arrangements should permit shutting off water immediately and taking the machine out of service if rubs develop.

4. Start admitting water through spray nozzles. Increase the amount until temperature between valve group and turbine cylinder drops to ten degrees above saturation for pressure indicated. Water-flow increase should take from one to four hours with temperature reading serving as a guide for uniform rate of temperature drop. For machines up to 7500-kw rating allow a two-hour period for bringing steam down to washing temperature.

5. Run the turbine for two hours at washing temperature and at specified load with constant water flow. Watch discharge from drains for an indication of the effectiveness of washing.

6. At end of two-hour washing reduce water flow gradually. Steam temperature increases as water flow drops off. Allow the same time for temperature to return to normal as was taken to reduce it.

7. Close off water supply to steam main. Ten minutes later close all drains.

8. If turbine is an axial-clearance type, move the spindle back to "running" position.

9. At full turbine load check pressure distribution if possible through pressure readings at different stages. Compare with readings before washing. Real test for blade cleanliness comes from pressure distribution.

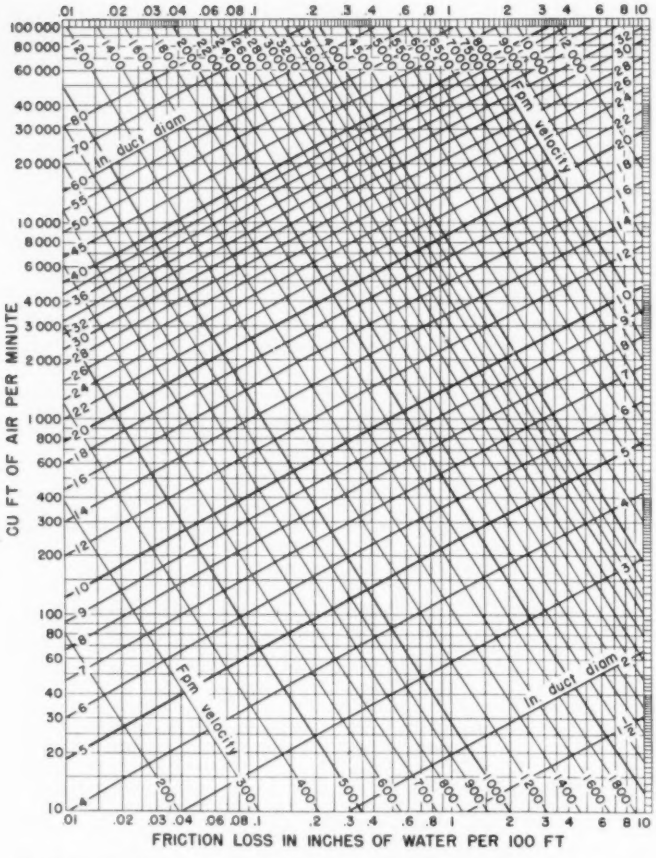
How It Works. Fig. 1 gives a schematic view of the essential elements in a turbine-washing program. If by any chance one-quarter load on the turbine gives a small steam flow, some troubles could develop. These troubles would be those created by the water not carrying through the turbine and settling out to form a water slug when turbine goes back to normal operation.

By blocking off the valve on the main

(*Continued on page 226*)

How to Figure Air Friction in Straight Commercial Ducts

Here is a method of calculating friction losses for given conditions. Actual resistance may differ because of variation in wall smoothness and accuracy of duct layout fabrication



For direct use with air of customary humidities at temperatures of 70 F ± 20 F and at absolute pressures of 29.92 in. Hg abs ± 20 in. water. For other air conditions where high accuracy is needed apply corrections given in text.

Chart applies to good-quality commercial ducting with about 40 joints of standard types per 100-ft run. For other duct roughnesses apply corrections of Fig. 2.

For noncircular ducts use *equivalent diameter* as explained in text.

Do not extrapolate to lower velocities or smaller ducts; reasonable extrapolation off the chart to right and upward is permissible.

1 Chart for air friction in straight commercial ducts with average roughness. From 1948 GUIDE of the American Society of Heating and Ventilating Engineers

By H B NOTTAGE

Research Laboratory, American Society of Heating and Ventilating Engineers

► SIMPLIFIED PRACTICAL METHODS are now available for calculating air friction in straight ducts. Fundamental data from research in fluid mechanics have been combined with tests and experience on commercial ducting to establish the friction chart in Fig. 1. This chart, sponsored by the American Society of Heating and Ventilating Engineers, represents the best information now available.

As an indication of the refinements introduced, the lines of Fig. 1 are slightly curved while in similar earlier charts straight lines were used. Standardization of friction calculations on this basis offers a means of overcoming the inadequacies of earlier contradictory sources of air-friction calculations. The chart covers the commonest conditions met in ventilating and air-conditioning systems. Accuracy of pressure losses read from this chart is considered to be in general as good or better than the practical agreement expected between advance ducting specifications and ultimate installations that are commercially and economically practicable.

The standard conditions for which the chart was prepared[1] are noted below the graph in Fig. 1. When friction calculations are required for other than these conditions, simple corrections may be made by multiplying the friction loss from the chart by suitable correcting factors.

Roughness Corrections. A quantitative measure of roughness is needed as a basis for corrections. This measure has been established as the particle diameter for a granular material which, when spread uniformly over the surface of a perfectly smooth duct, will yield the same friction as the practical duct

[1]All superscripts refer to the bibliography at the end of this article.

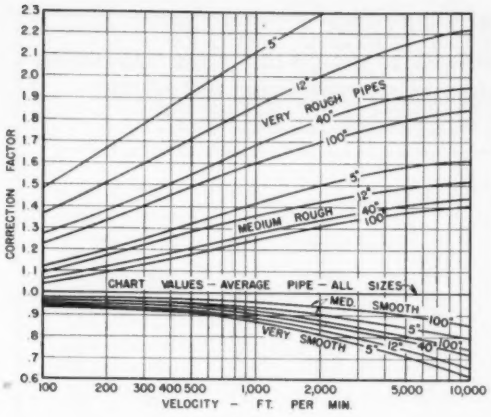


TABLE I – ROUGHNESS MAGNITUDES AND CLASSIFICATION

Degree of roughness	Representative practical material	e = roughness magnitude in feet
Very smooth	Drawn tubing	0.0000015
Med smooth	New steel or wrought iron pipe	0.00015
Average	Galvanized iron or sheet metal	0.0005
Med rough	Average concrete	0.003
Very rough	Avg riveted steel	0.01

2 Correction factors for other than average roughness to be applied as multipliers to friction loss from Fig. 1. Numbers on the curves are the duct diameters in inches

finish under consideration. Table I gives representative roughness magnitudes [2, 3] together with a classification of the degree of roughness. Note that the "average" classification has galvanized ducting with 40 good joints of standard types per 100 lineal feet of duct.

The influence of different roughnesses upon the friction pressure drop varies with the pipe diameter. Fig. 2 gives correction factors by which friction loss read from Fig. 1 should be *multiplied* for other than average roughness.

Air-Condition Corrections. Adjustments of friction pressure drops for nonstandard air pressure and temperature are conveniently based upon the *same flow velocity* for both standard and nonstandard air. When extreme departures from standard conditions are met, or where high accuracy is desired, it is best to go back to the original friction-factor data [1, 2] and recompute the pressure loss. For many practical cases, however, a simple multiplying correction factor will suffice. Empirical equations[1] which serve as the basis for simple approximate corrections are:

For very smooth ducts,

$$\frac{\Delta P}{\Delta P_s} = \left(\frac{P T_s}{P_s T}\right)^{0.81} \left(\frac{\mu}{\mu_s}\right)^{0.91} \qquad (1)$$

For average galvanized ducts,

$$\frac{\Delta P}{\Delta P_s} = \left(\frac{P T_s}{P_s T}\right)^{0.9} \left(\frac{\mu}{\mu_s}\right)^{0.1} \qquad (2)$$

For very rough ducts,

$$\frac{\Delta P}{\Delta P_s} = \frac{P T_s}{P_s T} \qquad (3)$$

ΔP = friction pressure loss
P = absolute pressure in duct
T = absolute air temperature in duct, F + 460
μ = absolute viscosity of air in duct (see Table II)

The subscript *s* refers to standard conditions, 70 F and 29.92 in. Hg abs, and no subscript refers to the conditions under consideration. Since all quantities enter the equations as ratios, *any consistent units* may be used, just so the same units are adopted for both standard and non-standard states. For example, *both* P and P_s may be in psi, in. Hg, in. water, mm Hg, or any other unit so long as *both* quantities are in the *same* unit. The ratio PT_s/P_sT represents the ratio of air density for the actual to the standard conditions. The quantity ΔP_s is read from Fig. 1.

Table II gives magnitudes of the factors in equations 1 and 2. No listing is given for equation 3 since direct proportionality only is involved. Table II is limited in extent because the empirical approximations are only valid for a restricted range. With regard to the magnitudes in Table II, it may be noted that corrections less than 10% are hardly worth making for many practical cases. Furthermore, using equation 3 with friction loss directly proportional to density is evidently about as good as equation 2 for commercial ducting.

Rectangular Ducts. Fig. 1 applies to circular ducts, but it may also be used for rectangular ducts with proper use of the concept of *equivalence* between circular and rectangular cross-sections. Recent tests[4] have established a practical validation of the rule of equivalence for large-scale ducts. This rule may be expressed in either of two forms. Let *a* and *b* (inches) be the sides of a rectangular duct and D_e (inches) be the diameter of an *equivalent* circular duct of average sheet-metal construction for use with Fig. 1 in obtaining friction losses. Then (1) to determine an equivalent diameter of circular duct for *equal air-flow capacity* and equal *friction*, use the formula:

$$D_e = 1.30 \sqrt[8]{\frac{(ab)^5}{(a+b)^2}} \qquad (4)$$

(2) to determine an equivalent diameter of circular duct for equal *velocity* and equal *friction*, use the formula:

$$D'_e = \frac{2ab}{a+b} \qquad (5)$$

The distinction between equal capacity and equal velocity is very important; the proper scale (quantity or velocity) must always be used on Fig. 1. In ventilating and air-conditioning systems the customary practice is to use the *capacity* equivalent, equation 4. An extensive tabular solution has been assembled for equation 4 and is available to facilitate rapid calculations.[4, 5]

Other Duct-Loss Problems. This article has dealt only with air flow in straight ducts with the air density remaining substantially constant. (A constant density at the average temperature and pressure is commonly employed where only slight changes in these quantities are involved.) It is well to recognize that occasionally special conditions may arise where the change in density along a duct becomes appreciable. Here more complicated design procedures are needed[6].

Straight-duct friction often amounts to a smaller portion of the total pressure drop in a duct system than does the total loss produced by fittings, transitions, dampers and abrupt contractions or expansions. Available authentic data on these other kinds of losses are quite limited in extent[5, 6, 7] so rough design approximations are frequently unavoidable. This deficiency will be remedied only as further progress is made through research.

References

1—"A New Friction Chart for Round Ducts" by D K Wright, Jr, *ASHVE Journal, Section of Heating, Piping and Air Conditioning*, Vol 17, No. 10, p 577, October-November 1946.

2—"Friction Factors for Pipe Flow" by L F Moody, *ASME Transactions*, Vol 66, p 671, 1944.

3—"Friction Charts for Gases Including Correction for Temperature, Viscosity and Pipe Roughness" by R D Madison and W R Elliott, *ASHVE Journal, Section of Heating, Piping and Air Conditioning*, Vol 18, No. 10, p 107, October 1946.

4—"Friction Equivalents for Round, Square and Rectangular Ducts" by R G Huebscher, *ASHVE Journal, Section of Heating, Piping and Air Conditioning*, Vol 18, No. 12, p 127, December 1947. (See erratum noted on p 172 of January 1948 issue of same magazine.

5—"Heating, Ventilating and Air Conditioning GUIDE, 1948," Chapter 41, American Society of Heating and Ventilating Engineers, New York, N. Y.

6—"Elementary Mechanics of Fluids" by Hunter Rouse, John Wiley and Sons, New York, 1946.

7—"Fan Engineering" edited by R D Madison, Buffalo Forge Co, Buffalo, N. Y., Fifth Edition, 1948.

TABLE II — MAGNITUDES OF FRICTION-LOSS CORRECTION FACTORS FOR NONSTANDARD AIR TEMPERATURE AND PRESSURE

To be used with equations (1) and (2).

Standard temperature and pressure are those employed in Fig. 1.

$\left(\frac{P}{P_s}\frac{T_s}{T}\right)$	$\left(\frac{P}{P_s}\frac{T_s}{T}\right)^{0.81}$	$\left(\frac{P}{P_s}\frac{T_s}{T}\right)^{0.9}$	$\left(\frac{T}{T_s}\right)$	Temp. F.	$\left(\frac{\mu}{\mu_s}\right)^{0.19}$	$\left(\frac{\mu}{\mu_s}\right)^{0.1}$
			0.80	—36	0.97	0.98
0.65	0.71	0.68	0.85	—10	.98	.99
.70	.75	.73	0.90	17	.98	.99
.75	.79	.77	0.95	43	.99	1.00
.80	.84	.82	1.00	70	1.00	1.00
.85	.88	.86	1.05	96	1.01	1.00
.90	.92	.91	1.10	123	1.01	1.00
.95	.96	.96	1.15	150	1.02	1.01
1.00	1.00	1.00	1.20	176	1.03	1.01
1.05	1.04	1.04	1.25	203	1.03	1.02
1.10	1.08	1.09	1.30	229	1.04	1.02
1.15	1.12	1.13	1.35	255	1.04	1.02
1.20	1.16	1.18	1.40	282	1.05	1.03
1.25	1.20	1.22				
1.30	1.24	1.27				
1.35	1.28	1.31				

Notes: (1) See comments in text regarding units.
(2) Absolute viscosity varies with temperature only and not with pressure within the range of conditions of concern here.
(3) The ratio ($P T_s / P_s T$) represents the ratio of air density at the prevailing conditions to that at the standard conditions.

Water Table Shows How Air Behaves When Flowing

► A MAJOR DIFFICULTY in designing equipment to handle moving air or to pass through air at subsonic and supersonic velocities is the inability to "see" what takes place. The water table, left, remedies this condition because a thin film of smoothly flowing water is found to behave similar to air when passing through channels or around objects. Shock waves that develop in air appear as distinct wave patterns in the water surface. Experimental investigations can be speeded up when results are seen in this manner. Conversion factors translate results with water to what may be expected with air.

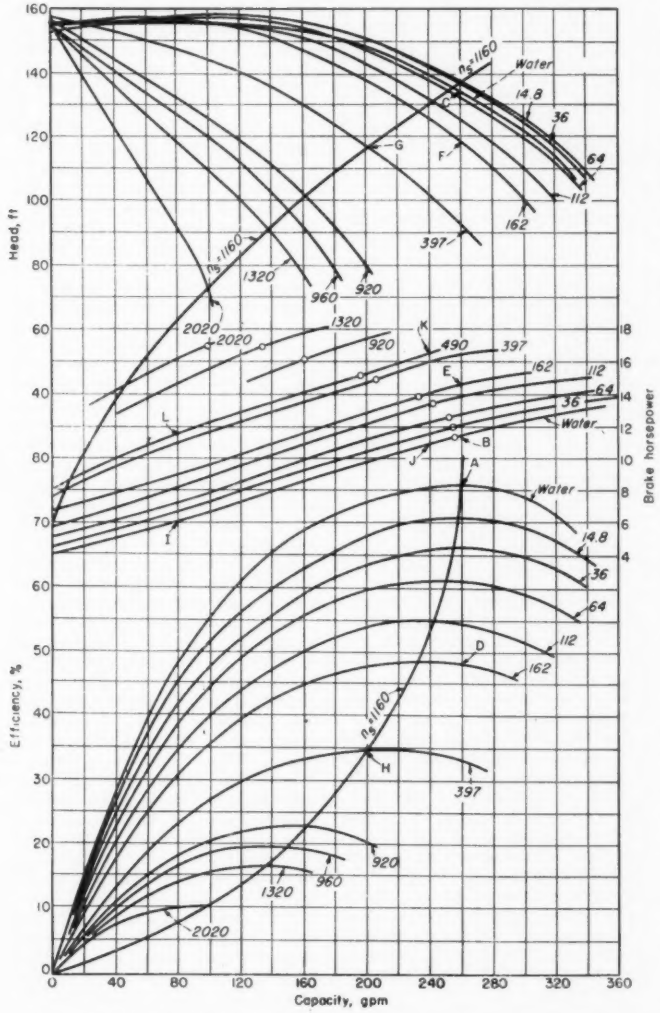
Water from a source tank, left in photo, flows through a screen to dampen any surface ripples and then over a smooth-surfaced round dam in a thin film. From the foot of the dam the water flows in a smooth sheet on the slightly tilted table to the right, discharging into a receiving tank from which it is pumped back to the source tank.

Professor H A Wilson, in photo, of Rensselaer Polytechnic Institute designed the water table in collaboration with Professor Neil P Bailey, head of ME department. The table will be used for Army and Navy jet programs as well as in undergraduate courses.

How Centrifugals Perform When Pumping Viscous Oils

By A J STEPANOFF
Engineer, Cameron Engineering Dept
Ingersoll-Rand Co

If centrifugal pump's water performance is known, here's a simple way to determine its head, capacity, power, efficiency curves for oils pumped at various viscosities



1 PUMP CHARACTERISTICS. Performance curves for 2-in. single-stage centrifugal handling oil at different viscosities compared to pump's performance on water

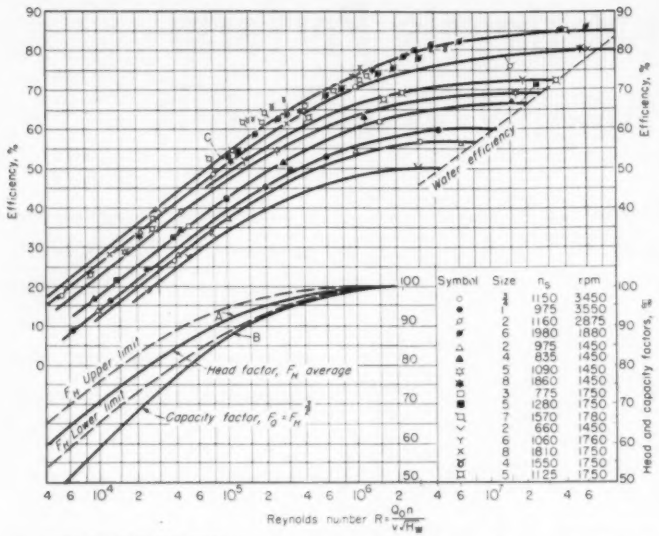
► IN PUMPING, petroleum products are next to water in importance. Of these products, oil with its high viscosity causes a centrifugal pump to change its characteristics from those it had when handling water. Performance when handling oil, however, may be calculated by comparatively simple methods as shown here.

Pump Characteristics. In general, a centrifugal pump when handling viscous liquids has its head and capacity reduced at best efficiency by increased friction losses. Brake horsepower increases, primarily because of increased friction of the liquid on the impeller. Fig. 1 shows head-capacity, power and efficiency curves obtained when pumping water, also curves obtained when pump was tested with petroleum products having kinematic viscosities from 14.8 to 2020 sq ft per sec, as given at the curve ends.

As an example of how a centrifugal pump's characteristics vary with viscosity of the liquid, take 260-gpm capacity, the pump's point of best efficiency on water. At this load, efficiency reaches 76%, point *A*, bhp is about 11.5, point *B*, and the head is about 133 ft, point *C*. If the pump must handle 260 gpm of 162-viscosity oil its efficiency drops to 48%, point *D*, power increases to 14.5 hp, point *E*, and the head developed by the pump decreases to 118.5 ft, point *F*. As viscosity of the oil increases pump performance grows progressively worse.

Performance of a pump handling viscous oils is generally estimated by using correction factors applied to water performance. This is done because the pump manufacturer's test facilities use water only; therefore, most of the accumulated data and experience are for this liquid.

Even when its water performance is



2 CORRECTION FACTORS. Centrifugal-pump head and capacity correction factors for viscosity at best efficiency points and efficiency curves of oil-tested pumps

known, it is impossible by purely theoretical means to determine the performance of a pump handling viscous oils. The following deductions suggested by theory have been proved experimentally.

Affinity Laws. For the relation between a pump's water performance and its speed, affinity laws are that capacity varies about as speed, head varies as speed squared, and power as speed cubed. These laws hold for all viscosities, but with less accuracy than for water. Usually the efficiency is better at higher speeds; therefore when speed increases, bhp increases less than the speed cubed, and head increases more than the speed squared.

When speed is changed, specific speed at best efficiency remains unchanged when viscous liquids are pumped, irrespective of deviation from the affinity laws given. Specific speed as used here is a pump-type number that represents hydraulic features of all similar pumps irrespective of size or speed. (See POWER, March 1947 for definition and discussion of specific speed.)

At constant speed a centrifugal pump's head-capacity relation decreases as viscosity increases in such a way that specific speed at best efficiency remains constant. This is shown in Fig. 1 as follows: If we take any point where the specific-speed curve crosses a head-capacity curve, and drop down to the corresponding efficiency curve, we find the specific-speed curve crossing it at the point of best efficiency.

For example, the specific-speed curve crosses the 397-viscosity head-capacity curve at *G*, at about 200 gpm and 118-ft head. Dropping down to the efficiency curve corresponding to this viscosity we find that the specific speed curve crosses it at *H*, the point of best efficiency.

If Q_1 and H_1 are the pump's capacity and head respectively at one viscosity, and Q_2 and H_2 the same for another viscosity, the relationship between the two can be expressed:

$$Q_1 \div Q_2 = (H_1 \div H_2)^{\frac{3}{4}} \qquad (1)$$

This is an important relationship because to estimate best efficiency when a viscous oil is being pumped, only one experimental correction factor is necessary. This may be that for either the head or capacity; the others will follow from equation (1).

Constant Speed. At constant speed the head-capacity relation decreases as viscosity increases. At zero capacity, however, the head remains essentially the same, which results in steeper head-capacity curves for high viscosities. This is evident in Fig. 1, where the head-capacity curves for the lower viscosities are reasonably flat. At the higher viscosities, such as 397 to 2020 the head-capacity curves rapidly grow progressively steeper with increased viscosity, but shutoff head is always around 155 ft.

Shutoff head can be affected more by the pump's casing when pumping viscous liquids than when pumping water. For instance, if the impeller's diameter is cut down to where there is a large gap between its periphery and the cut-water in the volute casing, shutoff head is lower for higher viscosities. Also, head drop at best efficiency is greater than for a normal impeller in the same casing. On the other hand, if an impeller is fitted too closely to the cut-water in the casing it develops a higher head than with water at low capacities, because of the viscous drag. For constant viscosity and variable speed, best efficiency point is higher at increased speeds.

Brake Horsepower. Fig. 1 shows that when viscous liquids are pumped, bhp increases the same amount for a wide capacity range. This is indicated by these curves being practically parallel. At a capacity of 80 gpm, when pumping water, power input is 6 hp, point *I*. When the liquid is 490-viscosity oil, power input is 11.5 hp, point *L*, difference 11.5–6=5.6 hp. At 240 gpm of water, power input is 11 hp, point *J*, where with 490-viscosity oil, it is 16.5 hp, point *K*, difference 16.5–11=5.5 hp, the same as at 80 gpm. Increase in power input because of viscosity is caused by increased disk-friction.

With increasing viscosity, friction in closely fitted running clearance between the impeller and stationary parts has increasing importance. Even an approximate determination of this loss is difficult because of the uncertain temperature of the oil in the clearances. Because leakage through the running clearances is negligible at high viscosities, liquid confined between the impeller shrouds and casing walls and adjacent to the running clearance may be at a higher temperature than the pumped liquid.

Bhp at best efficiency increases with viscosity. This means that even though the head and capacity drop with viscosity, the efficiency decreases more rapidly than the product of head and capacity. This is evident in Fig. 1 where maximum efficiency 76 for water drops to 10 for 2020-viscosity oil. Here, the product of head and capacity dropped 80% while the efficiency decreased 87%.

Estimating Performance. Performance of centrifugal pumps handling viscous liquids is usually calculated only for the best efficiency point, using correction factors based on test data. Two such factors are sufficient, one for head and one for efficiency.

When the head and capacity for best efficiency have been found the head-capacity curve is drawn by eye through the shutoff-head point, which remains practically the same irrespective of viscosity.

To complete the efficiency curve, bhp is calculated for the best efficiency

point, and the power curve drawn by eye. When doing this the general slope of the bhp curve for water is followed. Efficiency curve is then calculated for the bhp and head-capacity curves.

Fig. 2 shows the head correction factor and percent efficiency of several pumps plotted against Reynolds number:

$$R = \frac{Q_o n}{v\sqrt{H_w}} \qquad (2)$$

Where

Q_o = pump's oil capacity, cu ft per sec
n = pump speed, rpm
v = oil's kinematic viscosity, sq ft per sec
H_w = head of water in ft

For viscosities above 100 ssu (saybolt seconds universal) formula (2) becomes:

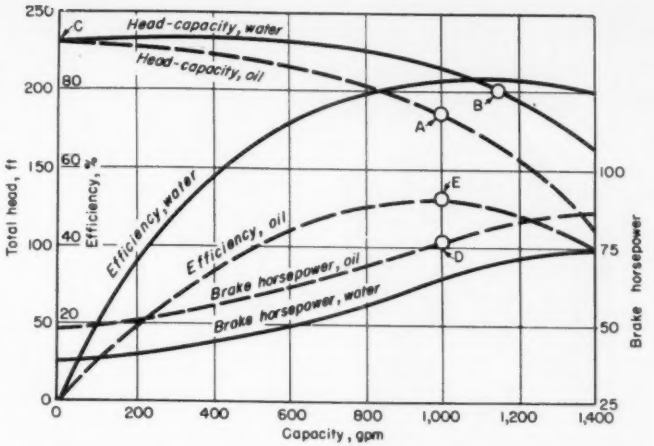
$$R = 941.6\,\frac{(\text{gpm})_o \times \text{rpm}}{\sqrt{H_w} \times \text{ssu}} \qquad (3)$$

Plotting the viscosity corrections against Reynolds numbers rather than viscosity provides for the effect of pump speed, size and specific speed. For Reynolds numbers lower than those in Fig. 2, efficiencies are higher than would be indicated by extending the curves at top of chart because of accumulative effect of heat in the pump at higher viscosities. This is also why small low-efficiency pumps show a smaller drop in efficiency than larger and better ones, as shown by the tendency of the curves to come together at the lower Reynolds numbers.

A number of pump tests investigated show considerably less falling off in efficiency for higher viscosities than indicated by the curves in Fig. 2. Each of these pumps, however, differed from a normal design. For instance, a pump with low water efficiency, because of excessive running clearances, showed a smaller efficiency drop at high viscosities—a condition accounted for by reduced leakage through the clearances.

Theoretically, all head correction points should plot on a single curve, but they scatter about an average curve, between the upper and lower limits, shown in dotted lines in the lower left. This is caused by the effects of the pump casing and by leakage through the clearance.

As an example, select and estimate the performance of a pump to deliver 1000 gpm against a total head of 185 ft of 1000 ssu viscosity oil and 0.85 specific gravity. Speed of 1760 rpm is selected first, then the Reynolds number is calculated using formula (3). Since the head on Water H_w is not yet known, the head on oil can be used for the first approximation.



3 **WATER AND OIL.** Head-capacity, efficiency and bhp curves for 5-in. double-suction centrifugal pump on water, also on 1000 ssu 0.85-specific-gravity oil

$$R = 941.6\,\frac{1000\text{x}1760}{\sqrt{185\text{x}1000}} = 122{,}000 = 1.22\text{x}10^5$$

On Fig. 2, for this Reynolds number the head-correction factor $F_H = 0.92$, point A on the average curve, and the capacity factor $F_Q = 0.875$, point B. This means that the pump selected should produce a head of water $H_w = 185 \div 0.92 = 200$ ft at a water capacity $Q_w = 1000 \div 0.875 = 1150$ gpm.

The Reynolds number is now calculated using a water head $H_w = 200$ in formula (3), which gives:

$$R = 941.6\,\frac{1000\text{x}1760}{\sqrt{200\text{x}1000}} = 117{,}000 = 1.17\text{x}10^5$$

Head and capacity factors for this corrected Reynolds number are practically the same as obtained in the first approximation. Then, the water-pump performance is 1150-gpm capacity, 200-ft head at 1760 rpm

A 5-in. pump with a water efficiency of 83% is indicated for these conditions. This pump's efficiency will drop to 52.5% when handling 1000 gpm of 1000 ssu oil as shown at point C, Fig. 2, for Reynolds number $1.17\text{x}10^5$

Fig. 3 shows the water and oil performance of this pump to meet the specified conditions. The calculated head-capacity point for oil is at A, and the corresponding point for water at B. The oil head-capacity curve is drawn by eye through the zero capacity point C, (which remains the same for oil as for water) and given operating point.

To draw the efficiency curve the bhp curve is drawn first. Bhp at operating conditions on oil is:

$$\text{Bhp} = \frac{1000\text{x}185\text{x}0.85}{3960\text{x}0.525} = 75.5$$

Then bhp curve for oil is drawn through this point, D, following the general direction of the curve for water. Efficiency curve for oil can now be computed from the bhp and the head-capacity curves for oil, for several points on the oil head-capacity by the formula:

$$E_o = \frac{(\text{gpm})_o \text{ x } H_o \text{ x } 0.85}{3960 \text{ x } (\text{bhp})_o}$$

which at best efficiency becomes

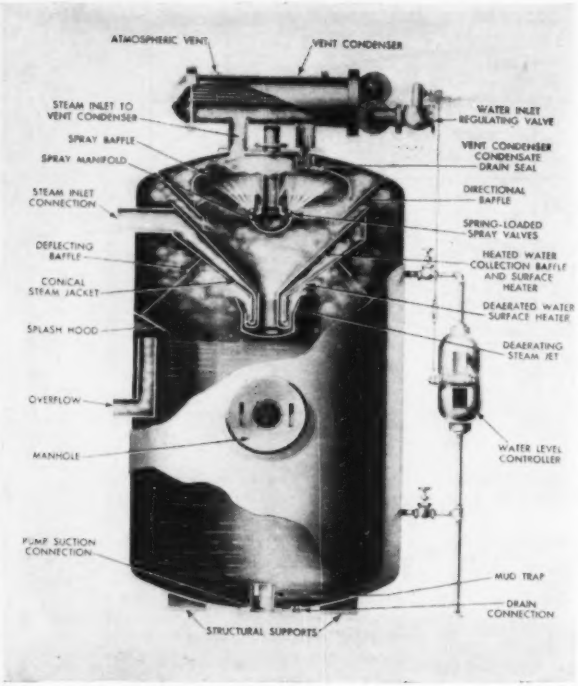
$$E_o = \frac{1000\text{x}185\text{x}0.85}{3.960\text{x}75.5} = 52.5\%$$

This is as given on the efficiency curve Fig. 3, point E.

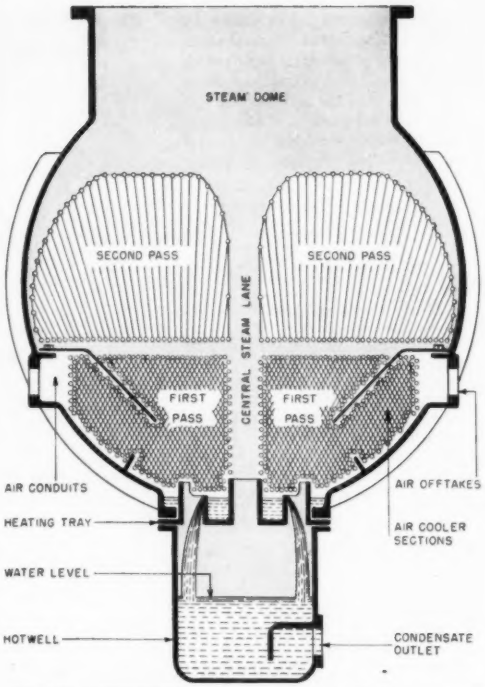
Expression for Reynolds number as used here was selected from several proposed for centrifugal pumps, because it does not contain the impeller diameter. Thus, water head-capacity rating of a pump for oil can be accurately estimated without knowing the pump size, by selecting its speed only.

Even though obtained primarily for variations of viscosity up to 15,000 ssu, the correction curves for head and efficiency, Fig. 2, apply equally if any other element is changed and viscosity kept constant (water). For instance, for a given pump size and speed, pumping water, chart gives pump efficiency changes in specific speed.

On the chart, the several efficiency curves represent the scale of mechanical and hydraulic perfection of pumps of different size and manufacture in the same way that the pipe flow data, when plotted against Reynolds number, give a family of curves representing a different roughness scale.



DEAERATING HEATER takes in feedwater through vent condenser, sprays it into space filled with the heating steam



SURFACE CONDENSER with deaerating hotwell has a central steam lane from inlet to heat condensate to saturation level

Two Ways to Oxygen-Free Feedwater

Here's a comparison of boiler feedwater deaeration in main condenser and in open heater in respect to: oxygen removal, operation, heat balance and over-all generating plant economy

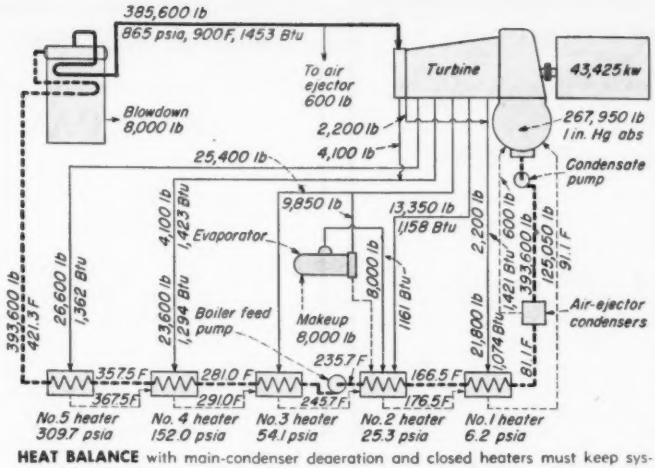
By **C A ADAMS**,
Gilbert Associates, Inc

► IN HIGH-PRESSURE STEAM PLANTS oxygen is removed from boiler feedwater by two methods: (1) open direct-contact deaerating heaters (2) surface condensers with deaerating hotwells. Of the two, the first method has been more generally used. Ultimate selection of deaerating equipment depends on the particular installation.

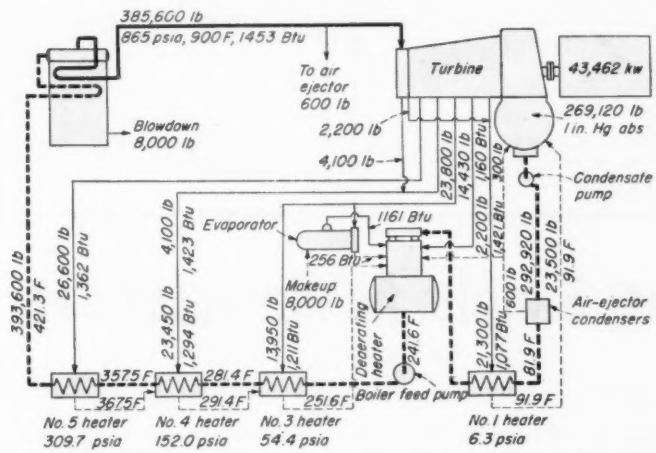
Deaerating Heaters. These open heaters are generally placed in the cycle ahead of the boiler feed pumps. They remove oxygen from the condensate and heat it to the steam-saturation temperature. In addition, the heater is a central water-storage point taking care of sudden increases in boiler-water demand. There are two types of heaters: (1) tray, in which feedwater cascades over a series of trays mixing with the surrounding steam (2) spray, in which feedwater sprays into a space filled with the heating steam. Either type is generally guaranteed to reduce feedwater oxygen content to about 0.005 cc per liter.

In the past it was often customary to set the deaerating heater's steam pressure slightly above atmospheric, about 5 psig, by a pressure-reducing valve. To obtain higher efficiency and counteract rising fuel costs the floating-type deaerating heater operating at bleed-steam pressure is now more frequently used.

Condenser Deaeration. Standards of the Heat Exchanger Institute state that the condensate oxygen content leaving the condenser shall be guaranteed not to exceed 0.03 cc per liter. In actual operation the oxygen content is much lower. Condensate deaerates by leading steam from the condenser inlet to the lowest point to reheat condensate back to saturation temperature in a tray. Condensate spills from the tray through the steam atmosphere to collect in the hotwell. Liberated oxygen vents off through the cooling-tube section to the air ejector. Either a large storage hotwell or an elevated surge tank can take care of sudden boiler-demand increases. A straight-line closed-heater cycle can easily be adapted to this arrangement.



HEAT BALANCE with main-condenser deaeration and closed heaters must keep system tight at all points against O_2, especially where pressures are subatmospheric



HEAT BALANCE with deaerating heater produces slightly greater output, has lower heat rate for same total heat input as above, requires higher equipment investment

Operation. The floating direct-contact deaerating heater introduces some operating complications, such as possibility of seizure in the boiler feed pumps resulting from flashing caused by a sudden pressure loss in the heater. Another possibility is flashing in emergency boiler-feedwater storage tanks in the event of overflow from the deaerator at high loads accompanied by high temperatures and pressures. Feed-pump seizure results from the vapor binding caused by flashing. The quick increase of temperature from the churning operation causes unequal expansion and lack of water endangers the wearing rings.

The pump-seizure hazard can be eliminated by installing baffles in the deaerator storage tank so that on sudden load loss the cooler incoming condensate can be diverted directly to the discharge pipe of the storage section. Some companies recommend making an auxiliary steam connection to the deaerator to maintain pressure in an emergency. The heater can also be located at a height above the boiler feed pumps so enough positive suction head is provided.

The closed-heater cycle usually used with deaerating condensers is probably easier to operate than cycles having an open heater. Preventing air leaking into the piping between hotwell and condensate pumps demands constant vigilance by the operators. There is also danger of oxygen contamination of the condensate drains in the low-pressure heater where pressure is below atmospheric. Some engineers feel that danger of condensate contamination in the condenser during start-up warrants use of a deaerating heater as insurance. With the straight-line heater arrangement between condensate and boiler-feed pumps there is a possibility of flashing in the feed pumps with sudden load changes.

Economy. To compare relative economies of the two feedwater deaeration methods, two heat balances shown in the diagrams, left, were calculated. Both are based on a standard 40,000-kw turbine-generator with 850-psig 900-F steam at throttle, five extraction stages and 1-in. Hg abs exhaust. Both cycles use an evaporator for makeup water. Note the difference in handling heater drains.

For the same boiler heat output the following gross turbine-cycle heat rates were found:

Deaeration in:	*Btu per kwhr*
Heater	10,863
Condenser	10,874

These heat rates are taken at the particular output developed for the cycle. On this basis the heater-deaeration cycle has a heat-rate saving of 11 Btu per kwhr. Actual reduction in heat rate for the *same* output in both cycles is slightly larger. Arbitrarily evaluating this heat saving for a 40,000-kw net rating, 70% plant factor, 88% boiler efficiency, 5% auxiliary power, 13,000 Btu per lb coal costing $7 per ton, the annual saving is:

$$\frac{11\times40{,}000\times0.7\times7\times8760}{13{,}000\times2000\times0.88\times0.95}=\$867$$

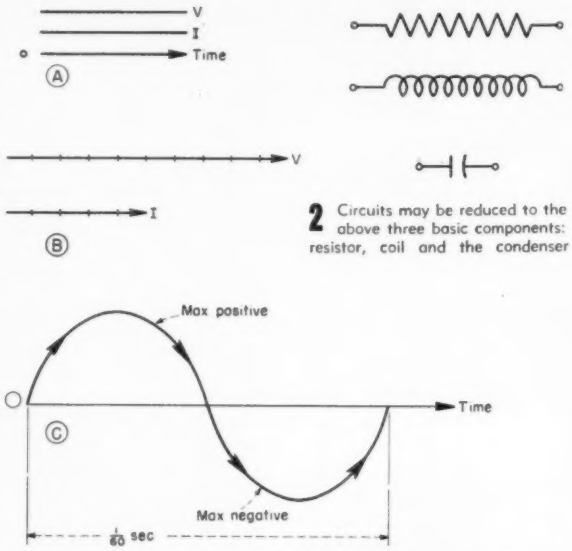
The capacity additionally produced by the heater-deaeration cycle, 37 kw, can also be evaluated as a capacity credit at whatever amount the nominal installation cost runs in terms of dollars per kw for the particular system.

Against these two credits for the heater-deaeration cycle must be balanced the extra costs for equipment. For heater deaeration the increment cost of an open heater over a closed one is about $16,000. Cost of additional feed piping to connect the elevated deaerator to the heater system would be about $500.

For condenser deaeration the increment cost for a larger storage hotwell, 12,000 gal, runs about $5000. The higher relative investment for heater deaeration is then about $11,500 above that for condenser deaeration. Capitalizing the annual fuel savings at most prevailing rates, plus the capacity credit, generally shows a practical standoff compared to the increment investments involved.

(*Continued on page* 172)

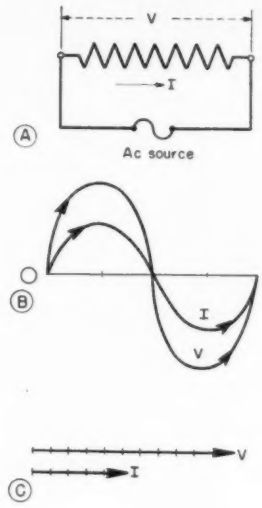
HERE ARE THE TOOLS FOR AC CALCULATIONS



2 Circuits may be reduced to the above three basic components: resistor, coil and the condenser

1 Direct current and direct voltage are represented graphically in *B*. Taking a direct current, and changing its magnitude and direction periodically, results in an alternating current as shown by the wave in *C*

PUTTING THE TOOLS TO WORK . . .



3 Voltage and current are right in step where the load is pure resistance; similar to *V* and *I* for dc, shown in *C*

Putting Simple Ac Calculations

To analyze and subsequently improve the power factor in your plant requires knowledge of simple ac calculations. Here's a fundamental approach that shows the transition from basic dc to the power triangle and then on to utility rate analysis

By H CARL BAUMAN

Chief Electrical Engineer, American Cyanamid Co

► MOST POWER ENGINEERS understand direct-current power calculations. But mention of alternating-current calculations, power factor, and how they weave into the monthly power bill are often points of confusion. Best approach is through a simple explanation showing how ac power calculations stem directly from fundamental dc relationships.

Dc Fundamentals. Dc is so-called because the current flows in one direction at all times in a circuit across which direct voltage is impressed. Direct voltage, *V*, and direct current, *I*, are represented graphically in Fig. 1*b*.

Arrowheads show direction of current and voltage. Both direct current and direct voltage always act in the same direction. Each division on the arrows represents a unit of current or voltage. Now if we assume each division equals 10, then the voltage arrow is equal to 100 v and the current arrow 50 amp.

To find dc power, P, simply multiply current and voltage, like this:

Power = VI or

P = 100x50 or 5000 watts

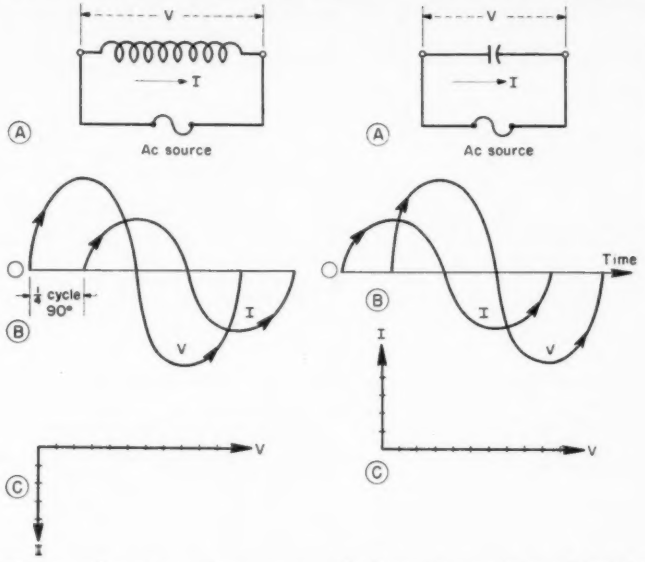
That's all there is to it. Pf is not considered.

Ac Circuits. Ac is so-called because the current in a circuit, upon which an alternating voltage is impressed, changes direction periodically. For example, in a 60-cycle circuit the current reverses direction completely 60 times each second, Fig. 1*c*.

In 1/60 of a second the current in this 60-cycle circuit increases from zero to a maximum value in one direction, then decreases to zero; after reversing direction it increases to a maximum in the opposite direction, then decreases again to zero completing one cycle. Sixty such cycles occur in one second.

Voltage goes through a similar sequence of changes in each cycle. But voltage and current cycles may not occur at the same time. The current cycle

. . . FINDING HOW VOLTAGE AND CURRENT BEHAVE IN AC CIRCUITS



4 Current through a coil having no resistance will lag alternating voltage by ¼ cycle as illustrated in *B* and *C*

5 Current in a condenser will lead the alternating voltage by ¼ cycle if no resistance or coil is in the circuit

To Practical Use

can start ahead, behind, or at the same time as the voltage cycle. That is, current can lead, lag, or be in step or phase with voltage. Type of circuit through which the current flows determines the relative positions of the voltage and current cycles.

Circuit Components. There are three fundamental types of electrical circuit elements; resistor, inductor, capacitor. Fig. 2. Typical electrical apparatus using resistors are electric irons, heaters, grids and incandescent lamp filaments.

The inductor or coil is the second basic circuit element. Typical electrical applications of the coil are in transformers, motor and generator windings, and relays.

Capacitor or condenser is the third electrical circuit element. In this group are radio condensers, pf correction condensers, and condensers used with fractional hp motors.

Current and Voltage Relations. Now let us assume we have a pure resistor—one having no coil or condenser characteristics. Current flowing through such a device is always in step with the voltage across it.

This is represented in Fig. 3*b* by the coincidence of the zero points of both voltage and current waves. As in dc, voltage and current can be represented by weighted arrows, each pointing in the same direction. Calculation of power is the same as for dc, namely active power = 100 v x 50 amp, or 5000 watts. Pf does not come into the picture for a pure resistor load since it mathematically equals unity.

Now let's assume a pure coil; one having no resistor or condenser characteristics. In a circuit containing such a device it is important to remember that current *lags* behind voltage by ¼ of a cycle or 90 deg, one complete cycle being 360 deg. This is shown in Fig. 4*b*. Note that the current passes through zero ¼ of a cycle after the voltage has passed through the zero axis.

This condition can also be represented by our current and voltage arrows if we assume the arrows pivot at their junction point and are capable of moving in a counterclockwise direction only. With this assumption the current arrow can be drawn 90 deg away from and lagging the voltage arrow.

Finally, let us assume a pure condenser—one having no resistor or coil characteristics. Putting this pure condenser in an ac circuit results in the current leading the voltage by ¼ of a cycle, or 90 deg. This is shown in Fig. 5*b* where the current passes through zero ¼ of a cycle before the voltage. Arrows in Fig. 5*C* indicate how this condition is represented. Assuming the same arrow rotation as for the coil (which is generally accepted), the current arrow is now drawn 90 deg in a counterclockwise direction from the voltage arrow.

Reactive Power. Both condenser and coil circuits are said to be *reactive*. It should now be apparent that in a pure reactive circuit, current and voltage are displaced from each other by 90 deg.

How about power in a reactive circuit? Remember that *active* power is obtained by multiplying current and voltage that are in phase; that is, when they can be represented by arrows pointing in the same direction. In a pure reactive circuit, current and voltage are not in phase, hence there can be no active power consumed in the circuit.

But since current flows in the circuit there must be a flow of power, which is not consumed in the circuit, but flows between the coil or condenser and the source of voltage applied to the circuit.

This power, which is not consumed in the circuit, is measured in va and is found by multiplying the voltage by current just as in dc, like this:

$$V \times I = va$$

$$100x50 = 5000 \text{ va}$$

And Now Pf. We are about ready for pf at this point. And pf is simply the active power consumed in the circuit divided by the total va flowing to the circuit.

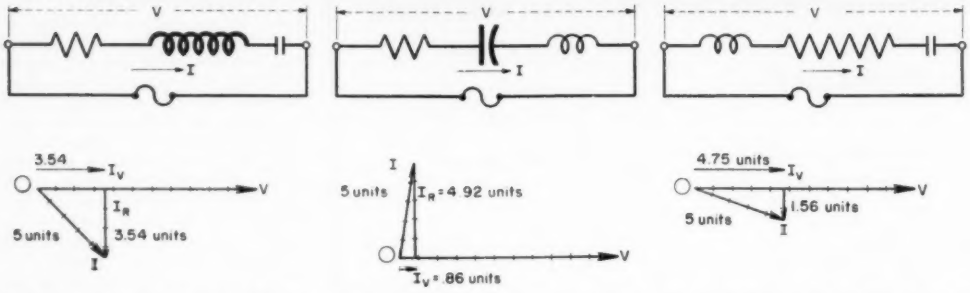
$$\text{Thus pf} = \frac{\text{active power (watts)}}{\text{total va}}$$

In the resistive circuit, active power = 100x50 = 5000 watts. Total va = 100x50 = 5000 va. Pf is therefore equal to 5000 ÷ 5000 = 1.0, or 100%.

In the coil circuit, active power is zero, and va power = 100x50 = 5000 va. Hence, the pf is 0 ÷ 5000 = 0. Similarly, the pf in the condenser circuit equals 0 ÷ 5000 = 0.

Combining Circuit Components. Up to now we have talked about pure resistance, pure coil and pure condenser

ALTERNATING CURRENT WILL LAG OR LEAD VOLTAGE DEPENDING ON CIRCUIT VALUES



6 Current lags when inductance is large compared to resistance and condenser

7 Where condenser is major element the current leads voltage in ac circuit

8 Angle between the current and voltage decreases when resistance is large

circuits. Of course, it is almost impossible to find such pure circuits in practical work. A coil is made from turns of wire, hence must have some resistance. It also has negligible capacity in addition to its inductance. A condenser has some resistance in its leads and plates. A resistor wire, wound on a cylindrical form, also has some coil and condenser characteristics.

This should not throw us out of step if it is remembered that currents in pure resistors are in phase with their voltages; currents in coils are out of phase, lagging, whereas currents in condensers are out of phase, leading their respective voltages.

Adding resistance to a pure coil has the effect of rotating the current arrow in a counterclockwise direction toward the stationary voltage arrow. This results in reducing the angle between the arrows. If resistance becomes large compared with inductance, the arrows (vectors) practically coincide. Now at this point if capacitance is inserted in the circuit the current arrow moves away from the voltage in a counterclockwise direction. Adding more capacitance widens this angle. If the capacitance becomes great compared with resistance and inductance, the current arrow will end up leading the voltage by almost 90 deg.

Simple Ac Calculation. Now let us assume a relay coil has an ac voltage, V, applied across its terminals. This coil has little resistance, large inductance, and very small condenser characteristics. The relay coil is represented by a stretched-out circuit in Fig. 6.

Since the relay coil is largely inductance the current lags almost 90 deg behind the voltage. Total va power flowing to the circuit is still V x I = 100x50 = 5000 va, or 5 kva.

The coil now consumes active power since there is a component of the total current which is in phase with the voltage because of the resistance present. This component is obtained by drawing a line from the tip of the current arrow, I, perpendicular to the voltage arrow, V. This can be done readily by using a right triangle. The component of current in phase with the voltage is that length on the voltage arrow between the origin, O, and the intersection of the perpendicular with the voltage line.

Active power in the coil is the product of the voltage, V, and the component of current I_r, in phase with V. This component measured on the arrow diagram is 3.54 units, or 35.4 amperes.

The active power in the circuit is then V x I_r = P, or 100x35.4 = 3540 watts, or 3.54 kw.

Now pf of the coil can be computed as the ratio of active to total va power:

$$\text{Pf} = \frac{\text{active power}}{\text{va}} = \frac{3540}{5000} = .707$$

or 70.7%

If we had assumed a condenser circuit, it could have been represented as in Fig. 7. Since a condenser has almost negligible resistance and inductance or coil characteristics the current leads the voltage by almost 90 deg.

Here, you can readily calculate the total va as 5000, and from the arrow diagram the total active power as 860 watts and pf as 0.172, or 17.2%.

If we had been talking about an electric heater the diagram would be represented as in Fig. 8. Since a heater has more inductance than capacitance the current lags the voltage as shown. You can now calculate, with the aid of a scale and right triangle, the values for total va as 5000, the active power as 4750 watts, and pf as 95%.

Defining Var. There is only one more basic concept to master, and that is the meaning of reactive va, often called vars. Divide by 1000 and you have kilovars.

This second component of current, which we have apparently neglected to this point, is 90 deg out of phase with the voltage. This component may be represented by the line drawn from the tip of the current arrow—in each case, perpendicular to the voltage. It always represents the pure reactive current flowing in the circuit. When the value of this arrow to scale is multiplied by the voltage, a quantity known as the reactive va, or var, results.

Thus for the coil, var = reactive component of current × volts or var = I_r × V. Hence var = 35.4x100 = 3540 reactive va or 3.54 kvar. Going back to the condenser we find it takes 4.92 kvar, and for the resistor it's 1.56 kvar.

Reactive va component of power in an ac circuit is not consumed in the load but oscillates between the source of power and the load.

Further Use for Power Triangles. We have now described active power, total va power, and var power. These quantities can be related to each other through the use of arrows or vector diagrams.

Remember that active power is always in phase with the circuit voltage, while total va power either lags or leads it by less than 90 deg. Amount of lag or lead depends on whether the circuit load has largely coil or condenser characteristics, respectively. Var power always lags or leads the circuit voltage by 90 deg.

In any given circuit the power quantities can be related by a right triangle of arrows, as in Fig. 9, p 93. It is now possible with the basic facts discussed, a right triangle, a suitable scale and a knowledge of simple arithmetic to make the following ac power computations: determination of pf, kvar, total kva and kilowatts, provided any two are known

for any circuit. We can go still further and use these tools for power-bill calculations, pf correction, total circuit current and generator loading.

Remember that the power triangle is drawn the same for 3-phase as for single-phase. We have naturally stuck to single-phase circuits for simplicity and have shown that total va = circuit amperes multiplied by the circuit voltage, or va = V x I, and kva = (V x I) ÷ 1000.

Three-Phase Calculations. For the 3-phase circuit, total va is the current in one line multiplied by the line-to-line voltage and multiplied again by $\sqrt{3}$, or 1.732. Hence va = V x I x 1.732 and kva = $\frac{\text{V x I x 1.732.}}{1000}$

Similarly, in the 2-phase circuit: va = V x I x $\sqrt{2}$ = V x I x 1.414 or kva = $\frac{\text{V x I x 1.414.}}{1000}$

You can compute the pf of your electrical system, a feeder or an individual load, such as a motor, with the aid of a wattmeter, voltmeter and ammeter—all readings taken simultaneously.

To determine pf, choose a convenient scale for the power triangle and lay out the wattmeter reading horizontally (to scale). Then multiply the ammeter reading by volts, read on the voltmeter connected line-to-line. This gives single phase va; for 3-phase va multiply by 1.732. To get pf divide watts by the va (kw by kva).

The kvar is obtained by taking the square root of the difference of the squares of kva and kw, or kvar = $\sqrt{(\text{kva})^2 - (\text{kw})^2}$

Lay out kvar to the same scale at the end of, and perpendicular to, the kw vector. Join the free ends of the kw and kvar arrows with a straight line. This line is the circuit kva to the same scale, Fig. 10.

Angle between the kw and kva arrows, is called the pf angle since its cosine, kw ÷ kva, is the circuit pf. The quantities in the power triangle are related to each other by the following simple formulas:

$$\text{pf} = \frac{\text{kw}}{\text{kva}}$$

$$\text{kw} = \text{pf} \times \text{kva}$$

$$\text{kvar} = \sqrt{(\text{kva})^2 - (\text{kw})^2}$$

$$\text{kva} = \sqrt{(\text{kw})^2 + (\text{kvar})^2}$$

$$\text{kw} = \sqrt{(\text{kva})^2 - (\text{kvar})^2}$$

Power Bill. How about that power bill? Now with the terms defined, we're ready to tackle the most involved rate schedules.

Remember first that most industrial power schedules are made up of two major components, *Demand charge* and *Energy charge*. Demand charge is based on kw or kva demand. When the kw demand is used, there probably is a pf clause that adds an additional charge if the pf is less than a predetermined amount.

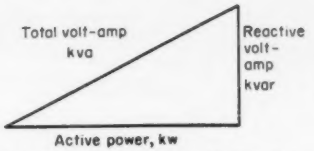
When the kva demand is used, there is no need for a pf clause since such a charge is included in the demand. This is evident on noting the relation between pf and kva, namely, kva = kw ÷ pf.

If the kw load were 100 the kva would be 125 at 0.80 pf and only 100 kva at unity or 100% pf. This shows it is good business sense to maintain as high a pf as possible.

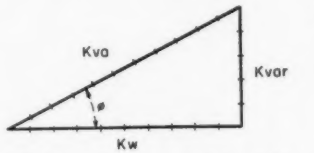
The energy charge is made up of the total kilowatt-hours consumed in the billing period, multiplied by the charge per kwhr.

Maximum Demand. Demand data for the bill are read from a demand meter, which records on a chart the maximum demand summed up over a given basic period, usually 15 or 30 min. The kva-demand data are similarly taken from a kva-demand meter while energy data (kilowatts) are read from an integrating kwhr meter.

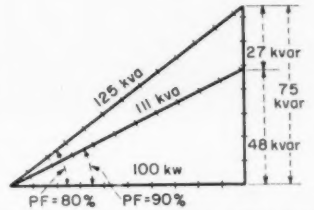
Some power companies also install a kvar, also called a rkva meter, to record on a chart the kvar in the circuit.



9 Here's the relationship between kva, active power and reactive volt-amp



10 Power factor is found by dividing active power, kw, by total kva drawn



11 Total kva decreases from 125 to 111 in this case, when pf was increased

If your power company gets its billing data from a kwhr meter, a kw-demand meter and a kvar meter, your bill is calculated as follows:

Max demand = 100 kw
Max kvar = 75 rkva
Max energy = 24,000 kwhr

The kva can then be calculated as kva = $\sqrt{(100)^2 + (75)^2}$ = 125; pf is equal to (100 ÷ 125) = 0.8, or 80%.

Details of the bill might be as follows:

Demand Charge

First 50 kw at 2.00	= $100
Next 50 kw at 1.50	= 75
All above 50 kw at 1.00	= —
Total demand charge	= $175

Energy Charge

First 10,000 kwhr at .02	= $200
Next 10,000 kwhr at .015	= 150
All above 20,000 kwhr at .01	= 40
Total energy charge	= $390

Pf clause may be $0.25 per kvar for less than 90% pf. Hence 27 kva × .25 = $6.75. Therefore the total monthly bill would be $571.75.

The pf clause is introduced by most utilities as a means to distributing cost of larger lines and equipment on an equitable basis. At 80% pf and assumed voltage of 440, current taken by the load in our example is 165 amp, while at 90% pf the current is 146 amp.

By improving the pf to 90%, transmission lines supplying the load can carry an additional 11.5% of power with the same voltage drop as at 80% pf.

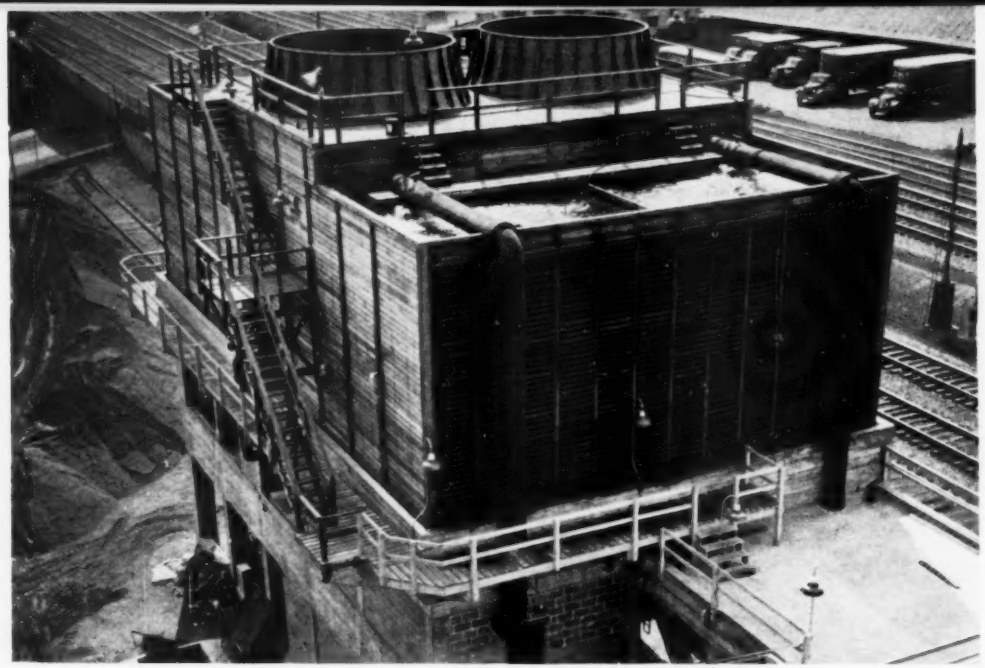
Economics of High pf. If pf can be corrected to 90% a saving of $6.75 per month, or $81 a year, can be realized in addition to savings from reduced I^2R losses. The power triangle can be used to determine the amount of kvar needed to correct from 80% to 90%.

When speaking of pf in industrial plants we imply pf is lagging since most load consists of induction motors, transformers and lighting. These all have large inductance or coil characteristics; hence uncorrected pf is bound to be lagging.

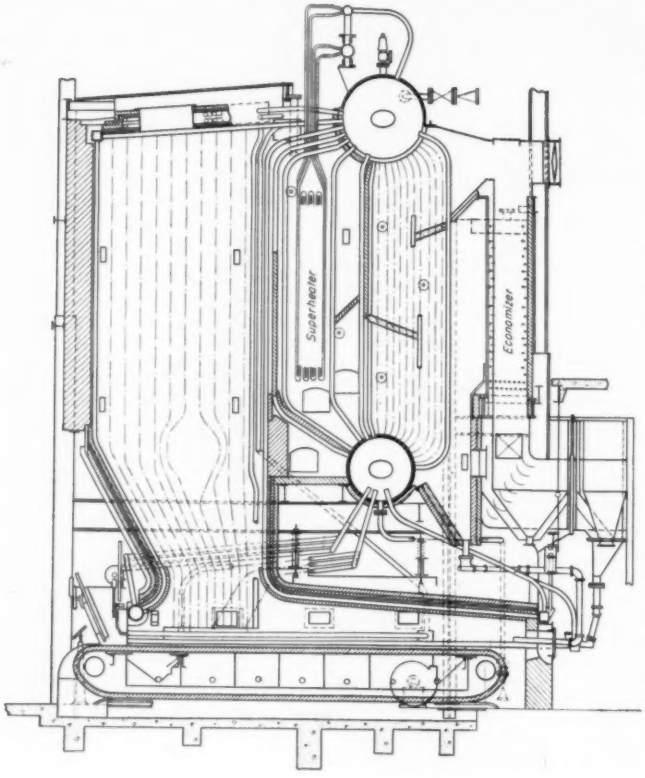
To correct pf means adding enough devices with leading pf characteristics to overcome some of the lagging characteristics of the load. In condensers, you will recall, current always leads voltage, and so these are suitable leading pf devices. Synchronous motors may also be used both to supply mechanical load and to improve pf.

Let us analyze a typical case showing

(*Continued on page 166*)



1 Two of the primary raw materials for power-plant service are water and coal. Cooling tower, above, handles the condenser circulating water. Beneath is the thaw house where the incoming coal cars, frozen in the winter, are thawed out



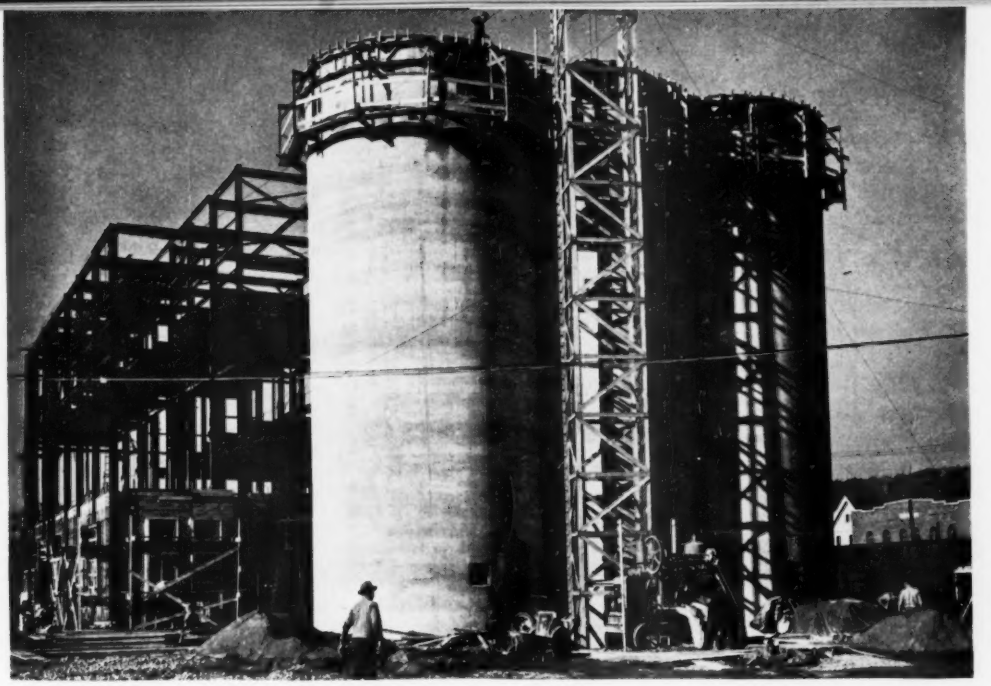
2 Three traveling-grate anthracite-fired boilers are conservative in design; heat release 24,000 Btu per cu ft

Top consideration in film manufacture is a constant power source with an unvarying voltage supply. Ansco's Binghamton plant has this asset

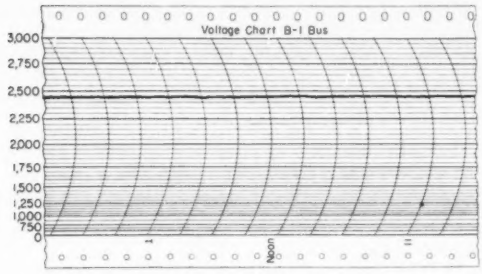
A Steady

► LARGE-SCALE PHOTOGRAPHIC-FILM manufacture involves widespread plant facilities and ample steam and electric services. To insure such a power supply the Ansco Film Div of General Aniline and Film Corp put up a new power plant to replace its older, outgrown one.

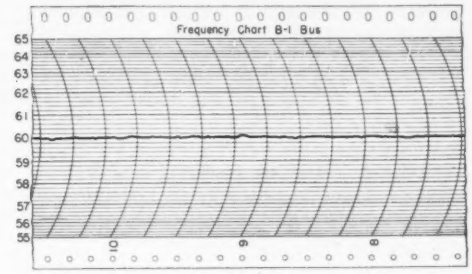
Steam Cycle. The basic decision to build for reliable power carries throughout the plant. There are three 40,000-lb-per-hr steam generators. These units can supply sufficient steam at 650 psi and 750 F for all heating and process



3 Silos receive the coal, either No. 3 or No. 4 buckwheat, from thaw house unloading point, Fig. 1, and deliver it either to outdoor storage or through coal scales to overhead conveyors supplying the individual hoppers of the boiler units



4 Electrical energy for process use must be very steady. The voltage output can vary only within narrow limits



5 Frequency of output energy is also closely regulated by a speed corrector to hold turbine speed within a set range

Service Features Film-Plant Power

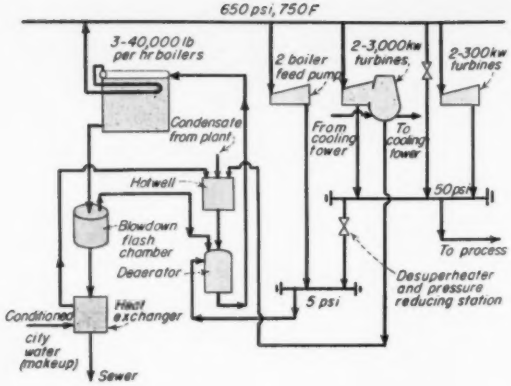
needs of the various present plant buildings.

They are of conservative design, Fig. 2. Heat release for the traveling-grate anthracite-fired boilers runs 24,000 Btu per cu ft at rated load. With waterwalls, total heating surface amounts to 6940 sq ft; furnace volume is 2600 cu ft. There is no air heater but an 1800-sq-ft economizer has been included.

Coal, No. 4 buckwheat, for the units arrives by rail at the plant. During the winter months the coal cars often freeze up. So a thaw house under the cooling tower, Fig. 1, receives the incoming cars. Underneath and between the railroad tracks in the thaw house are oil-heated thawing pits. Spaced the distance between railroad car hoppers, these pits melt off the ice and allow the coal to flow freely. Steam lances, shoved into the coal car itself, speed up the thawing process, when desired.

From this unloading point coal goes to silos, Fig. 3, for delivery either to an outdoor storage pile or through coal scales to overhead conveyors supplying the individual coal hoppers. These individual hoppers hold about a 3-hr supply.

The coal enters the furnace under control of a gate. This gate establishes fuel-bed thickness, which can be varied with changes in firing rates. The construction of the traveling grate employs fingers or keys slid on a crossbar to form the grate surface. These fingers overlap to reduce the quantity of siftings falling through to the windbox.



6 Steam enters a 650-psi, 750-F header for power-plant distribution; 300-kw turbine exhaust, bleed steam from 3000 units and a reducing station serve process

What siftings do get into the windbox are conveyed through a screw conveyor to dribble bins under the boiler, then by truck to the coal pile. These siftings run 90% coal.

Because the fuel-bed resistance must of necessity vary as the traveling grate moves through the furnace and combustion progresses, the stoker is zoned with a damper in each zone to regulate its air pressure. Air enters from the bottom. Special provision in the way of seals has been made to reduce air leakage. The underfire air enters the windbox at room temperature.

Gas Mixing. Arches are employed in the furnace for two purposes: (1) ignition (2) mixing. The front arch acts as the ignition one. It reflects heat to the incoming fuel to raise its temperature and provide quick ignition. The rear arch, much longer, directs the gas and air mixture, mostly air, from the rear area back toward the front to mix with the richer gas in that region. The excess air from the back thus helps supply the air deficiency in the front end and reduces over-all excess air.

Combustion gas passes from the furnace zone and under control of baffles moves through the convection section. Changes in gas-flow direction permit cinder and flyash particles to settle out and be collected in the cinder catcher. Before this gas stream reaches the 200-ft stack it goes through an 1800-sq-ft economizer and its temperature drops to 415 F by the time it leaves the economizer.

The steam generated in these boiler units enters a 650-psi 750-F header, Fig. 6, for distribution within the power plant itself. Coming off this header are two 3000-kw extraction turbine-generators, two 300-kw backpressure turbine-generators and a steam-driven boiler feed pump. Exhaust from the feed pump goes directly to the feedwater heater; and that from the two 300-kw turbines combines with bleed steam from the 3000-kw unit to supply process and heating steam at 50 psi.

All condensate and process returns go to a hotwell and from there they are pumped into a 6000-gal deaerating heater. Here they are joined by the makeup, roughly 30%, from 125-gpm water softeners. City water acts as a supply source for makeup needs.

Steam reaching the 3000-kw turbine exhaust passes through a condenser. Cooling water for this condenser comes from wells that feed into the cooling-tower discharge. This well water has been used twice in plant processes before its use in the condenser. Water then circulates through the condenser and back to the cooling tower for reuse. Chemicals are added to prevent slime and scale formation.

Electrical System. Electrical power from the various turbine-generators, discussed above, is generated at 2400 v, 60 cycles. This output power is closely watched. Both voltage and frequency are regulated within close limits, Fig. 4. 5—the voltage by close regulator action and the frequency by a speed corrector that holds turbine speed within a very narrow range, + or − 1/10th of a cycle.

This 2400-v energy goes to individual unit substations throughout the plant for stepdown to desired voltage level. Electricity for plant services comes off at levels of 480, 240 and 120v.

PRINCIPAL POWER-PLANT EQUIPMENT

Ansco Film Div, General Aniline and Film Corp, Binghamton, N. Y.

STEAM GENERATION

Boilers, 3 ..... Combustion Engrg-Superheater, Inc
40,000 lb per hr, 600 psi, 750 F
Stokers, (Coxe) ..... Combustion Engrg-Superheater, Inc
Stokers, (Coxe) ..... Combustion Engrg-Superheater, Inc
Traveling grate, anthracite
Silos, three, 550 ton ..... Wm Neil Constructors
Conveyors, coal ..... Jeffrey Mfg Co
Scales, coal ..... Richardson Scale Co
Soot blowers, steam operated ..... Diamond Power Specialty Corp
Cinder-recovery system ..... United Conveyor Co

POWER AUXILIARIES:

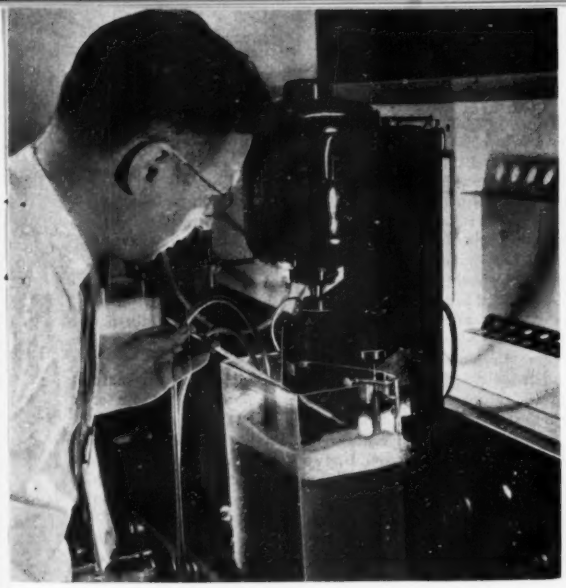
Drives, stoker, 3 ..... Reeves Pulley Co
Fans, vane control ..... Sturtevant Div, Westinghouse Elec Corp
Induced, 3, 1 per boiler; forced, 3, 1 per boiler
Pumps, boiler feed, 3 ..... Pennsylvania Pump & Compressor Co
1, Louis Allis, motor driven; 2 Elliott, turbine driven
Flash tank, 1 ..... Cochrane Corp
Deaerator, one, 6000 gal ..... Cochrane Corp
Heat exchanger, 1 ..... Cochrane Corp
Blower, cinder-collection system ..... American Blower Co
Cooling tower, 1 ..... Marley Co

BOILER-ROOM CONTROLS:

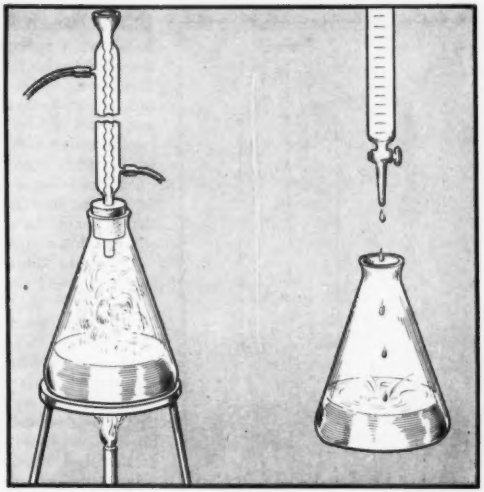
CO_2 meters (Micromax) ..... Leeds & Northrup Co
Combustion ..... Republic Flow Meters Co
Flowmeters ..... Bailey Meter Co
Temperature, recording (Micromax) ..... Leeds & Northrup Co
Gages, pressure, water (Ashcroft) ..... Manning, Maxwell & Moore
Gages, pressure, steam (Crosby) ..... Steam Gage & Valve Co

ELECTRICAL GENERATION AND EQUIPMENT:

Turbine-generators ..... General Electric Co
Two, 3000 kw, 2400 v, 60 cycles; two, 300 kw
Turbine condensers, two, 2250 sq ft, 2-pass ..... Worthington P & M Corp
Switchgear ..... Westinghouse Electric Corp
Starter, boiler feed pump ..... General Electric Co
Pumps, circulating water, 2 ..... Worthington P & M Corp
Pumps, hotwell, 2 ..... Worthington P & M Corp
Softeners, water anthracite reagent ..... Worthington P & M Corp
Water treatment ..... Hall Laboratories



1 In addition to chemical checks, others are needed to tell complete story. Simulated field-service test is shown above



2 Apparatus for "cooking" of fat in saponification number oil test shown at left. Equipment for titration at right

Significance of Chemical Tests In Lubricating-Oil Specifications

Buyer, user, oil supplier are constantly faced with lengthy lube-oil specifications supplied either by the manufacturer or requested by the consumer. The following outline explains what lube-oil chemical tests mean and why they are lengthy*

► SPECIFICATIONS for lube oil are often lengthy since one oil can be used with many types of machinery. In addition, the manufacturers' guaranteed limits cover oil requirements for various applications of his equipment. In other instances, lubricant has been designed for a single complex mechanism when better than average lubrication is essential.

Test specifications are of four principal types: physical, chemical, combination of physical and chemical tests, and performance tests. While this article limits itself to chemical tests, remember that individual tests are likely to be misleading and the whole picture, including physical and performance tests, must be considered when evaluating lubricants.

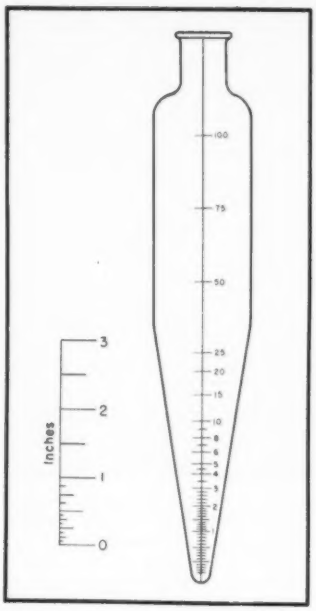
Saponification Number. Number of milligrams of potassium hydroxide required to saponify (decompose fats by adding an alkali) one gram of the oil is the saponification number. It measures the quantity of neutral fats and fatty acids present. Its principal value to the consumer is in buying compounded oils, which contain percentages of fatty oil or fatty acid. Once the saponification number for an oil containing fats or fatty acids has been established, the consumer, by checking the saponification number of subsequent deliveries, can calculate the percentage of fats and fatty acids present and in this way determine the uniformity of the shipments.

Neutralization Number. Number of milligrams of potassium hydroxide required to neutralize the acidity in one gram of oil is its neutralization number. It represents the total quantity of both mineral and organic acidity present. If oil to be tested is alkaline, one gram is neutralized with standard acid solution. Then the neutralization number is the number of milligrams of potassium hydroxide necessary to neutralize the quantity of acid used.

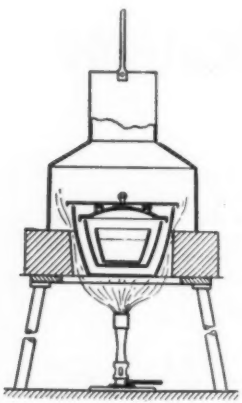
Saponification number involves cooking the oil, Fig. 2, with a solution of alcoholic potassium hydroxide and adding acid till color of solution changes. In running a neutralization number test, only the acidic materials present as organic or inorganic acids are neutralized by the alkali.

All mineral oils, even those which are thoroughly refined, have a small

*Based on a paper, by William Eismann Jr, supervisor, lubrication research, E F Houghton & Co, presented at the third annual convention of the American Society of Lubrication Engineers.



3 Cone-shaped tube used with centrifuge determines oil's precipitation No.



4 After oil distills the carbon residue is expressed in percent of the sample

neutralization number. Neutralization number of refined mineral oil usually runs from a trace to 0.1. Higher neutralization numbers are usually found on oils containing additives.

Neutralization number can be used as one of the inspection tests on new oils but the largest application for this test is in indicating amount of deterioration due to breakdown of used oil. This is particularly true in testing hydraulic, transformer, turbine, motor and diesel oils. For the last two, presence of additives in the oil or contamination from combustion products may affect results. Rate of increase in neutralization number of an oil in service has often been used to determine if oil is breaking down. Limits can be set up that indicate the point at which the oil should be drained and replaced with fresh material.

Crankcase Oil Dilution. In internal combustion engines, unburned portions of fuel may get into the crankcase. This contamination is known as crankcase dilution. When present in excessive amounts, it may be harmful by lowering viscosity of lubricating oil to cause breakdown of lubricating film. Test is run by boiling a sample of diluted oil with water, which vaporizes volatile fuel in oil with steam. It is then condensed and the volatile material separated. This dilution is an indication of the engine's operating temperature. Sometimes it is also a measure of the quality of the fuel or the mechanical condition of the piston rings and cylinders, or of both.

A high percentage of dilution will reduce the oil's viscosity allowing undue wear of moving parts. Excessively diluted oil means engine is running "too cold" and steps should be taken to raise water-jacket temperatures. Excessive idling may also be the reason for excessive dilution. Further causes of excessive crankcase dilution may be: worn or warped pistons, rings and cylinders.

Precipitation. Oil's precipitation number is that percentage of material which is insoluble in a special petroleum naphtha after mixture of oil and naphtha have been centrifuged.

In new oil, the precipitated matter is called tar or asphalts.

Highly refined oils have lower precipitation numbers than those not so treated. As a general rule, low-viscosity oils have low or no precipitation number.

In used oils, the sediment obtained after determining the precipitation number may contain water, dirt, metallic particles or other materials insoluble in the solvent. This test can therefore be used to measure effectiveness of filtering system.

Ash Content. The ash content of an oil determines the quantity of noncombustible material present. It is obtained by burning a weighed quantity of oil, then igniting and weighing the ash. Avoid mechanical losses throughout the test.

Refined oils contain very little or no ash unless they have been treated with metallic additives. This test is of importance when analyzing used oils. It can be used as a quick method of measuring the loss of additives when it is known that the fresh oil contained a definite amount of ash-forming material. It is also used as the basic step toward determining presence of certain impurities in used oil as a result of contamination.

Carbon Residue. When an oil is vaporized and burned in the absence of air, it leaves a residue that is called carbon residue.

Generally speaking, heavy oils have higher carbon residues than those of light viscosity. But since petroleum products are mixtures of many compounds, two oils having a similar viscosity may vary considerably with respect to amount and type of carbon obtained with this test.

Oils containing ash-forming additives naturally show higher carbon residues than untreated oils. Likewise, used oils containing contaminants previously mentioned give misleading results when subjected to this test.

This test was originally designed to predict amount of carbon that may form when an oil is subjected to high temperatures. This prediction may be made if factors that may influence results are considered. Factors that have a marked effect upon amount of carbon deposited by an oil in an internal-combustion engine are viscosity, oxidation susceptibility, engine's mechanical condition, cleanliness of intake and fuel-carburetion conditions.

Some consumers have found this test useful in helping predict performance of oils used to lubricate conveyor systems which operate at high temperatures.

Corrosion Tests. Corrosion tests are accelerated tests to establish potential corrosivity of a lubricant. Nearly all petroleum products contain sulphur, even after the oil has been subjected to the various refining processes. This sulphur is present in many different chemical forms. Many lubricating oils also contain sulphur or its compounds, which the supplier has added for a definite reason. To make the problem more complicated, modern machinery is no longer made from just steel and there are any number of metals, or combinations, that may come in contact with the lubricant. Higher operating temperatures further complicate the problem.

From the standpoint of corrosion consider the following factors when choosing a lubricant:

1. What metals will be in contact with the lubricant?
2. What will the maximum operating temperature be?
3. Will air or moisture, or both,

travel through the lubricating system?

Simplest and shortest corrosion test is one involving a test period of 3 hours at 212 F, adopted by the U. S. Government to determine corrosive properties of lubricating oils. Usually a polished copper strip is used.

Correct interpretation of corrosion test results also deserves consideration. Many lubricants that may tend to discolor metals are quite satisfactory for the job for which they were intended. A bright reddish stain is often obtained on copper if fatty oils are present. Corrosion to watch for is the type causing dark brown or black stains, visible pitting of the metals, etching and visible loss of metal.

Oxidation Tests. All lubricating oils deteriorate in service. Rate and extent to which this occurs determines life expectancy of the oil. When deterioration does occur, it is generally accompanied by oxidation and the formation of oxidation products. This is the most frequent type of deterioration since air is always in contact with the oil during the operation of a lubrication system.

Heat has a definite effect on oxidation rate. Under average operating conditions life of an oil is reduced about 50% for every 15-deg rise above 140 F. Generally speaking, heavy oils have greater resistance to heat than light oils and oxidize at a slower rate under similar conditions.

Some metals also have an undesirable catalytic effect on oils, particularly at elevated temperatures. Zinc, brass, copper and lead are among the common metals that have the greatest effect. Metals are most active as catalysts when present in a finely divided form.

Extent to which oxidation takes place depends on the type of oil, type and extent of refining, and whether it has been treated with oxidation inhibitors.

There are many types of oxidation tests available. These procedures include combinations of the following: (1) contacting the oil with air or oxygen (2) prescribed temperature (3) definite time (4) agitation during test period (5) moisture (6) presence of metal catalysts.

Results of oxidation tests are reported as: (1) measurement of sludge formed (2) increase in neutralization number (3) measurement of viscosity increase (4) time required to produce a specified quantity of sludge or acidity.

There is no universal evaluation test for oxidation deterioration. Evaluation tests that are available must be recognized as being applicable for specific types of service. There has been a great tendency to borrow a test method designed for some specific service for the testing of a lubricant that is to be used under entirely different conditions. For example, the Indiana Oxidation Test, which was designed to evaluate performance of motor oils and is run at a temperature of 341 F, should not be used to predict performance of hydraulic oils or turbine oils that normally operate at much lower temperatures.

Since oxidation proceeds more rapidly at elevated temperatures there has been a tendency to raise the temperature of the procedure to obtain results in a shorter period of time. This is often false economy. Error of such practice has been recognized by some consumers and tests are being used that require 1000 hours or longer at temperature of 95 C. The ASTM "Tentative Method of Test for Oxidation Characteristics of Inhibited Steam Turbine Oils," ASTM Designation D-943-47T is one of this type.

This word of caution is particularly applicable to testing of light-viscosity mineral oils. An oil having a flashpoint of 320 F is not intended by the producer to be used on an application that may reach this temperature. Therefore, generally speaking, accelerated oxidation tests should not be run at temperatures above the oil's flashpoint.

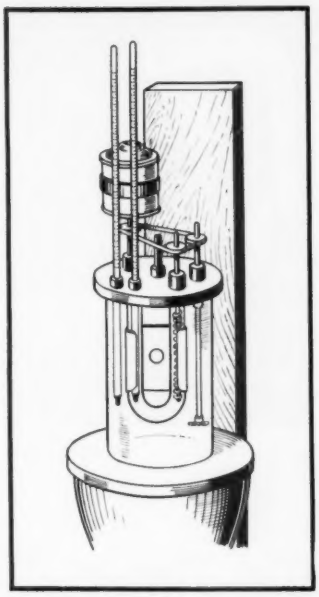
Correlation between results obtained by laboratory tests and those obtained in actual practice are many times general because of almost infinite variations found in machine design and plant operating conditions. These oxidation tests are intended to serve as a guide toward elimination of unsatisfactory lubricants.

Aniline Point. The aniline point test was originally designed to measure solvency power of petroleum naphthas. But as a result of synthetic rubber being introduced into many systems containing lubricants, its use has also been extended as a means of predicting the behavior of oils on rubber.

Petroleum products, while containing a vast number of organic compounds, are composed principally of three hydrocarbons known as paraffins, naphthenes and aromatics. Aniline is an aromatic chemical and, as such, is more compatible with aromatic hydrocarbons than it is with paraffins or naphthenes. Test is run by heating a mixture of equal parts of aniline and the oil until they are homogenous, and then cooling until first complete turbidity appears. Temperature at which this occurs is the aniline point.

Generally, oils with a low aniline point, indicating a predominance of aromatic constituents, soften synthetic rubber much more rapidly than oils with a high aniline point, causing faster rubber swelling.

This test is definitely an indicative one and actual swelling tests should be conducted for correct evaluation. This becomes more necessary as the number and the types of synthetic rubber are increased.



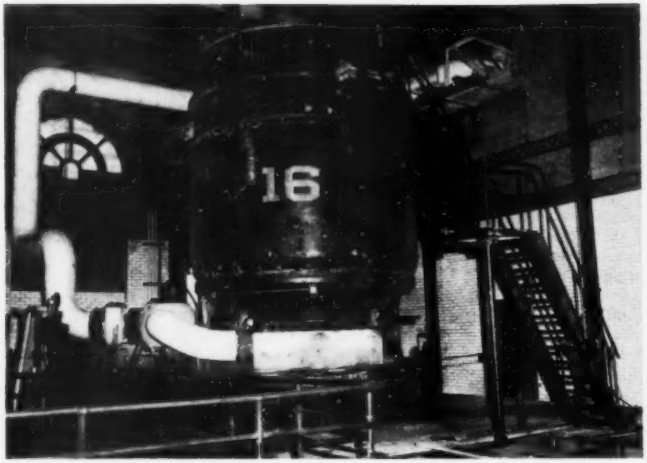
5 Aniline point test is used to predict the behavior of lube oils on rubber

Sulphur, Chlorine, Phosphorus. Sulphur is present in lubricants from the crude petroleum and as an additive. When it is present as a constituent in the oil, it has little effect on the lubricating qualities except it may possibly cause corrosion. Modern refining procedures, however, usually remove all of the corrosive forms of sulphur from oil. Sulphur alone, or more often in the form of a chemical compound, can be found in rust preventives, film-strength additives, detergents, anticorrosion compounds and antioxidants.

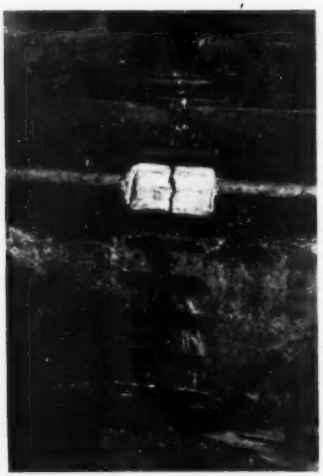
Chlorine is present in lubricants only as an additive and, in practically all instances, the additive is one designed to improve film strength.

Phosphorus is present in lubricants as an additive. It may be found in oils containing rust preventive, film strength, detergent, anticorrosion or antioxidant additives.

From the standpoint of the consumer, tests for these elements are used to determine amount of additive in an oil. This can be used either as a means for checking shipments or for indicating the amount of additive remaining in a used oil. Determinations for these elements are made by standard ASTM procedures.



20,000-KW VERTICAL TURBINE-GENERATOR in its new location in Glenwood Station on the Hudson River. The whole unit is supported by a surface condenser below



CRACKS IN COVER PLATE and stool piece were strengthened with Metalocks

Old-Timer Resumes Duty at New Spot

Vertical unit, removed from Waterside to make room for new toppers, is reinstalled at Glenwood for reserve duty. Here's story of various problems met and their solution

By E J ACKERMAN
Mechanical Engineering Dept
Consolidated Edison Co of N. Y., Inc

► WHEN THREE 20,000-kw vertical turbine-generators were removed from Waterside Station No. 1 of the Consolidated Edison Co of N. Y. in 1946 to make room for two new 60,000-kw condensing units, it was decided to reinstall one of them in Glenwood Station. This old unit thus became part of a major revamping program at Glenwood Station, The Yonkers Electric Light & Power Co, one of the Consolidated Edison System Companies. The station is located on the Hudson River.

Of the 20 stoker-fired boilers in this old station, 14 had been previously converted to oil firing. The remaining six were similarly changed. In addition, new boiler steam leads and main steam header were installed, as well as a new condensate system including a deaerating heater and chemical-treating plant for boiler makeup.

The vertical turbine-generator, a General Electric unit, was originally installed at Waterside in 1912. It had been in almost daily operation up to the time of removal.

The 6-stage Curtis unit drives the direct-connected 20,000-kw 10-pole generator at 720 rpm. A Wheeler condenser with a main center unit supporting the turbine-generator has two wing sections on the sides. Each turbine stage has a set of nozzles, two sets of revolving buckets and a single set of intermediate reversing buckets. Steam enters through a strainer and combined throttle and emergency trip valve to the steam chest and then, under control of the governor valves, to the first-stage nozzles.

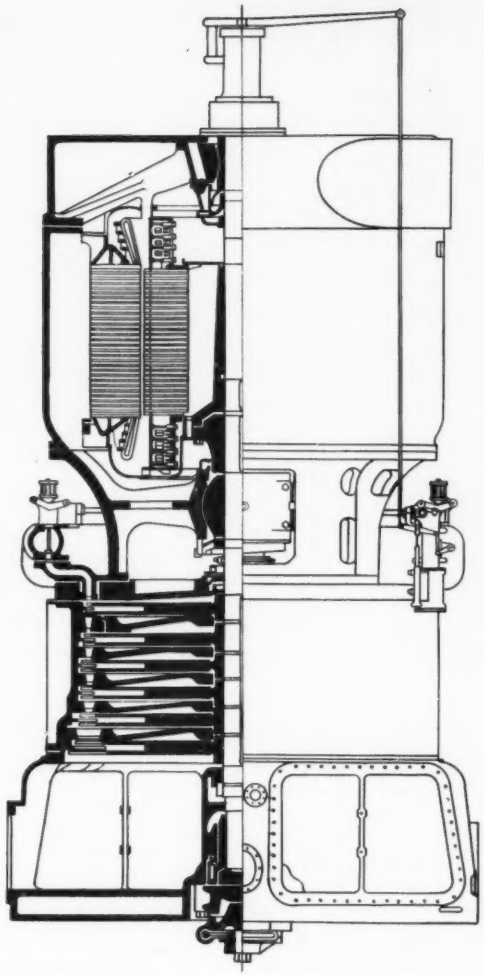
An inherent unbalance produces a slight closing pressure on the throttle valve. Since its seat is slightly larger than the balancing piston, the valve is held positively to the seat. When opening the valve, an integral bypass valve first opens to pass steam from above the balancing piston, relieving pressure above the valve. The emergency governor consists of a single split ring supported by a steel collar on the shaft. Eccentricity at over-speeds causes a trip finger to unlatch the trip mechanism on the throttle valve of the steam turbine.

Steam-inlet valves are positioned by a hydraulic-operating mechanism actuated by a conventional centrifugal-type governor mounted on top of the main shaft. The hydraulic system has a cylinder receiving oil under pressure through a pilot valve controlled by the governor. Piston rod of the cylinder carries a rack meshing with a pinion on a camshaft positioning the valve cams.

Repairs. After dismantling the unit two conditions were found: (1) surface cracks on the turbine shaft (2) cracks in the turbine's top cover plate and in the generator stool piece. A magnaflux inspection of the shaft showed the cracks were not serious and had probably been there many years.

Cracks in the turbine's cover plate were repaired by the Metalock process. Cracks in the generator stool piece did not impair its strength in compression and were probably caused by expansion and contraction of the turbine's cover plate to which it bolts. Closing these cracks would probably result in the formation of others that might cause a more vulnerable condition. Metalocks were inserted at the ends of the most serious cracks to prevent further growth, but no attempt was made to seal the cracks themselves.

When the generator was set in position on its stool piece the unit was out of line on its vertical center line. This was caused by growth and distortion of the



GENERATOR ON TOP and 6-stage velocity-compounded turbine, center, originally supported on step bearing below the shaft now ride on a Kingsbury thrust bearing

turbine casing flanges and aggravated by a slight warping of the condenser steam flanges. The unit was dismantled to machine the turbine flanges in a true horizontal plane. This work was done in the shops of the Todd Shipyard and New York Navy Yard, which were the only ones in the area with machine facilities able to handle the 15-ft-dia pieces. To compensate for the condenser warping, the flange was machined with a portable rig set up in position without otherwise disturbing the condenser. Finally, to compensate for the metal removed from the flanges, it was necessary to readjust the internal clearances of the turbine wheels and diaphragms.

Thrust Bearing. The rotor originally mounted on a standard-type step bearing consisting of two horizontal disk-type bearing surfaces. One turned with the 110-ton rotor and the other was the stationary support with an oil film separating the two faces. A positive-displacement pump fed high-pressure oil to this bearing and an oil accumulator. The latter maintained oil pressure long enough to bring the machine to rest if the bearing pump failed.

Installing this lubricating system at Glenwood would have involved considerable expense. Instead, a Kingsbury thrust bearing with six thrust shoes mounted on a stationary baseplate on which the 32½-in.-dia runner rotates was installed. No major alterations were needed since the thrust bearing, operating on 15- to 20-psig oil pressure, fitted into the original step-bearing housing.

Auxiliaries. Two steam-driven circulating-water pumps came with the unit from Waterside, one for normal service and one spare. Two 335-hp turbines drive the 22,500-gpm pumps through reduction gears. The pumps take their suction and discharge through existing water tunnels. Space limitations required reversing the hand of one pump. Since they are double suction, symmetrical about their vertical center lines, this was a comparatively simple alteration. It required a new turbine with opposite rotation, however, since rebuilding the original turbine would have been almost as expensive as the new drive. The original double-helical reduction gear was reused, but it was necessary to reverse rotation of the main-gear rotary oil pump since it is driven from the main gear shaft. Driving the reduction gear in the opposite direction has a possible advantage in that the helical gears now contact on the lesser worn faces of the teeth.

Also reinstalled were the original two hotwell pumps, 600 gpm against a head of 77 ft, with their 30-hp turbines. The original condenser hotwell could not be fitted into the available space and a new one was fabricated of steel plate. The available submergence over hotwell pump center line equals that provided by the original hotwell.

Oil System. One common lubricating-oil system takes care of all needs of the unit. It consists of a 750-gal reservoir, two oil pumps, an oil cooler, a twin oil strainer and a centrifuge. The oil is an unblended non-inhibited turbine oil with a viscosity of 215 ssu at 100 F and 108 ssu at 130 F and a specific gravity of 0.88 at 60 F.

One turbine-driven oil pump serves in normal operation, a motor-driven pump in emergencies. A pressure switch starts the latter pump on loss of oil pressure in the pump-discharge header. These pumps have a capacity of 100 gpm each at 1200 rpm and a discharge head of 75 psi. Oil distributes as follows:

Journal (guide) bearings	31 gpm
Hydraulic cylinder for steam inlet valve (intermittent)	20 gpm
Kingsbury thrust bearing	45 gpm
Total	96 gpm

A 225-sq-ft tubular exchanger, sal-

(*Continued on page* 162)

SPEAKING OF POWER

From his World News outpost in Melbourne, Australia, Herb Leopold tells us that the thermal region of New Zealand may be developed to supplement the Dominion's hydroelectric resources. At Larderello, Italy, nature's own underground boilers supply substantial amounts of steam that have been harnessed for power and industrial use for many years (see POWER, Nov 1939, p 691). Two Italian experts, with experience in developing power from volcanic steam and geysers, will be invited to New Zealand.

★ ★ ★ ★

What is believed to be the first industrial application of a mechanical-drive gas turbine will be made soon on the Mississippi River Fuel Corp's gas pipeline between Monroe, La. and St. Louis, Mo. The 2000-hp gas turbine built by Westinghouse Electric Corp and tested for more than 1000 hours at their South Philadelphia Works (see POWER, Mar 1948, pp 80-2) will drive an Ingersoll-Rand compressor at 8750 rpm for a 6-month trial period.

From this cooperative effort of the three companies involved will come information on the performance of gas turbines in pipeline service. Expected advantages of gas-turbine drive are: (1) high energy output per lb of weight in a compact unit that can be trucked into remote areas, set on a simple concrete-mat foundation and made ready for operation in a few hours (2) no need for water and only small lubricating-oil requirements, and (3) few moving parts, promising minimum maintenance.

★ ★ ★ ★

The statisticians have been having their fun ever since 1948 figures became available and they have come up with some interesting records on what everyone realizes, in a general sort of way, was an extremely busy year. Here are some samples:

Value of mineral fuels produced in 1948 was 30% greater than in 1947, according to the Bureau of Mines. This reflects higher prices and also a record-breaking output of petroleum. Crude production gained 8% and exceeded 2 billion barrels for the first time. Average value was up to $2.59 per bbl. Natural-gas production went up 10% in response to insistent demand, while bituminous-coal output slid off 5% from the record production of 631 million tons in 1947. Work stoppages in March and April, plus reduced exports and domestic demand in the latter half of the year accounted for the reversal of trend in coal.

With demand for aluminum continuing high, Aluminum Co of America reported that 6% of 1948 shipments went into power-transmission, making this one of the important uses of the metal.

Westinghouse Electric Corp's steam division shipped 2 million kw of turbine-generators, 43% above 1947's record figure and two-and-a-half times the company's best prewar output. Present orders call for production during the next three years at average annual rates twice as high as the best prewar year and 1950 output is expected to exceed 1948's all-time high.

★ ★ ★ ★

E F Otten, of the Ocean Accident & Guarantee Corp, being highly safety conscious as a result of his experience in the insurance field, raises a point regarding the cover picture on the January issue. You remember that the photographer posed the operator manipulating a valve handwheel with the new B & W sulphite-recovery boiler at Weyerhaeuser Timber Co in the background. With only the problem of getting a dramatic picture in mind, they naturally overlooked Mr Otten's safety pointer—keep out of the line of the valve to avoid injury if the packing should blow out.

★ ★ ★ ★

We're on the way to setting some records of our own, we believe. The special section, "Fuels and Firing" (Dec 1948) is to be bound into 6000 copies of the *Keystone Coal Buyer's Manual*. As of this writing, a little over two months after the section appeared, we have filled more than 10,000 orders for reprints in addition to the 6000 for Keystone. It looks as if we would have to go back on the press for more copies to meet the continuing enthusiastic response to this condensed handbook.

★ ★ ★ ★

Back last June we described the 1800-hp radial internal-combustion engines developed by Nordberg Mfg Co, in cooperation with the Aluminum Co of America and reported that 80 of these units, driving vertical dc generators, were to be installed to serve two pot lines in a new aluminum plant in Texas. On a recent visit to the Nordberg shops we saw more large-frame castings, connecting rods and other engine parts than we have ever seen in one place and learned that another pot line has been projected, requiring an additional 40 engines. On the basis of net output (less power taken by the scavenging blower) this comes close to 200,000 hp, making it by far the largest internal-combustion-engine plant in the world. These units, of the spark-ignition type, will burn low-cost gas.

★ ★ ★ ★

As a result of an agreement reached recently between the U. S., Great Britain and Canada, we are now on the way to standardization of all ordinary bolts, nuts and screws. This agreement was reached after 30 years of negotiation and eliminates a 5% variation in thread angle which has existed for more than 80 years. Minor modifications in the top and bottom of the thread contour will also be made.

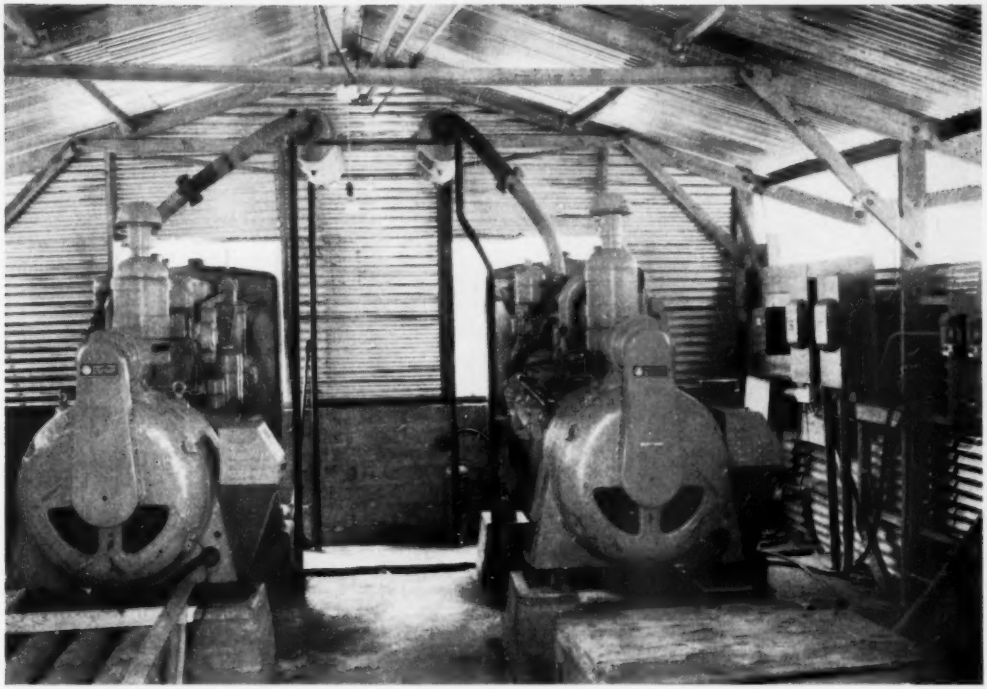
First move toward putting the new standard in practice will be made in military equipment, with industrial changes being made gradually over a period of years. It is expected that as dies, taps, gages, tools, etc, wear out they will be replaced by ones conforming to the new standards. Ultimate savings from this standardization will prove enormous.

THIS MONTH'S COVER

To the photographic fans and weekend snapshot makers among POWER readers, the name "Ansco" has long been familiar as a producer of fine films and photographic supplies. It thus seems entirely natural that a story on the power facilities at General Aniline & Film Corp's Binghamton plant should be illustrated with good "shots" (see pp 94 to 96).

In this installation, two 3000-kw 650-psi 750-F extraction turbine-generators and two 300-kw back-pressure units supply 2400-v 60-cycle electrical energy to main buses. These, in turn, supply unit substations spotted throughout the plant for stepdown to the desired voltage level. Steam at 50 psi from extraction points of the main turbines, plus exhaust from the back-pressure units, enters a header serving plant process needs. A 650-to-50-psi reducing and desuperheating station also feeds the process header.

Photo selected for the cover shows main units in foreground, with condensers mounted alongside, and bus structure and switchgear in the background.



Radio Station WTAL Goes Diesel

► FOR MANY YEARS diesel-electric sets have found use as standby power for radio transmitting stations but use of diesel power for full-time operation is comparatively new. One of the first stations to take this step was WTAL (AM and FM) at Tallahassee, Fla. They recently installed two 50-kw sets as part of a construction program incident to initiating FM transmission.

Reasons for Choice. In deciding on a power source for the transmitter, W A Snowden, Jr. chief engineer, gave weight to some of the difficulties met in operating on transmission-line power. In past experience, voltage fluctuations sometimes exceeded the requirement of at least 10% regulation for efficient operation of the electronic equipment. Also, the prevalence of electrical storms in the area caused line surges often sufficient to burn out fuses and tubes and interrupt broadcasts.

It was thus considered advisable to generate power at the station and two Caterpillar Tractor Co D8800 diesel-electric sets were selected for the job. Average operating load for the station is about 27 kw and demand is fairly steady, with a peak load of about 35 kw. Since each set is good for 50 kw, there is an adequate margin for unforeseen loads and future expansion.

Going off the air during a scheduled broadcast is costly and the cost increases with the duration of the shutdown. Hence, regardless of the type of supply, standby power is desirable and justified as insurance. This is the reason for installation of two sets, either of which can handle peak loads with a margin of reserve. To minimize maintenance cost and insure long life, the sets operate on alternate days with one serving as standby.

Plant Layout. At WTAL, equipment is installed in a transmitter house, with the power plant in a small building about 150 ft away. The power house has a concrete floor and corrugated-metal siding and roof. Layout provides ample space for maintenance and servicing and there is room behind the generating sets for possible addition of a small workshop.

The sets mount on vibration-isolating materials. Residential-district-type Maxim silencers on each engine minimize noise. Adjustable openings at both ends of the building insure adequate ventilation.

Two 3000-gal tanks, partially buried about 30 ft from the plant, store fuel for the diesels. All fuel lines running to the engines are buried.

Electrical Equipment. Switchgear for the units mounts conveniently on the power-house wall. This equipment consists of a standard Caterpillar synchronizing box with lamps, two knife switches and a junction box. Two transformers step down the 240-v 3-phase current generated to 120-v, single-phase. Transformer on one circuit serves FM equipment while the other is for antennae obstruction lights if power from the local REA line fails.

Broadcasts originate from studios in the Hotel Cherokee in downtown Tallahassee; the transmitter is located in a semi-isolated district near Lake Bradford, five miles southwest of the city. The station operates 18 hours a day on week days and 17 hours on Sunday.

You will be glad you selected RILEY

A few of the outstanding features which assure satisfactory performance from Riley Traveling Grate Spreader Stokers . . .

1 Feeder Drive

The completely enclosed splash lubricated Riley feeder drive assures long trouble free operation and provides complete speed control from zero feed to maximum.

2 Overthrowing Distributor

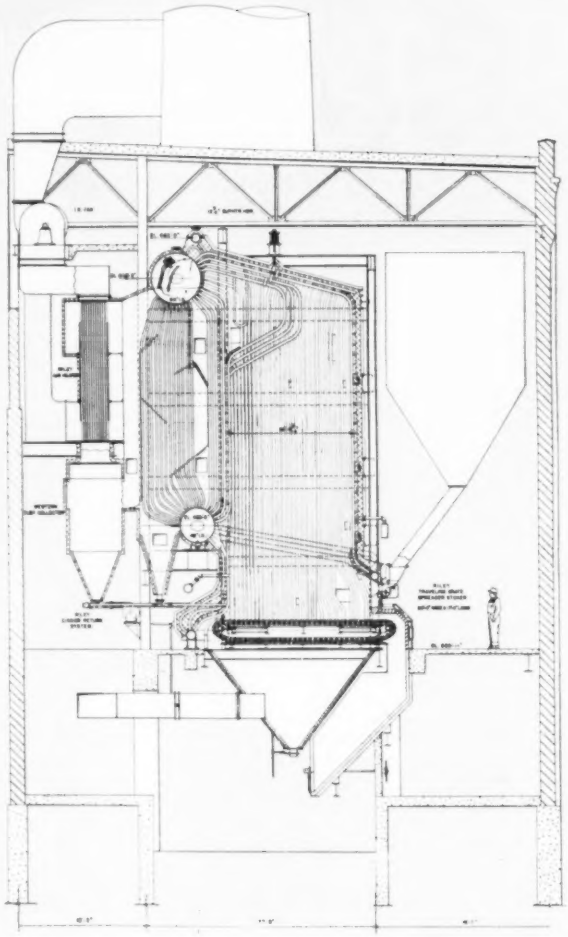
The Riley overthrowing distributor with adjustable blades provides uniform lateral and longitudinal distribution. Ready access to distributor is provided from front of stoker.

3 Hydraulic Grate Drive

Riley uses a hydraulically driven ratchet drive completely enclosed and automatically lubricated which is not susceptible to damage in case of grate obstruction and which requires but little power to drive.

4 Efficient Grate Surface

The Riley grate surface consists of grates 2″ wide by 6″ pitch assuring uniform air distribution and low maintenance. The grate clips are mounted on carrier bars which in turn are fastened to roller conveyor chains giving a true traveling grate surface.



Central Illinois Light Co., Springfield, Ill.
125,000 lbs./hr. Riley Steam Generating Unit
fired by 20′ x 17′ Riley Traveling Grate Spreader Stoker

TRADE MARK Rx REGISTERED

RILEY

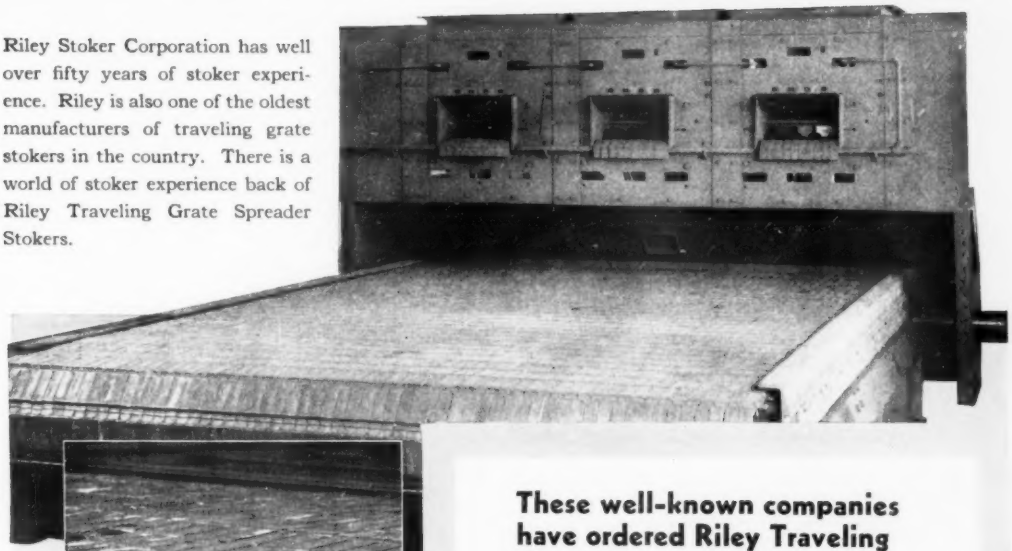
STOKER CORPORATION, WORCESTER, MASS.

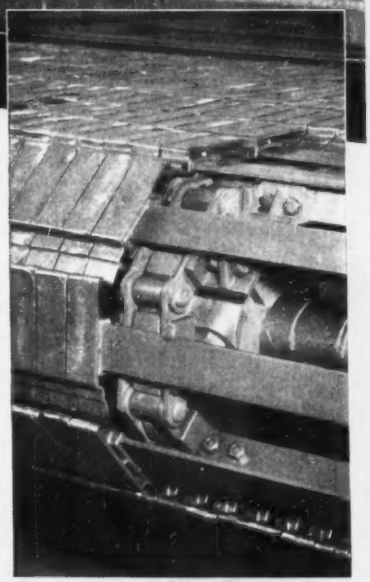
Boston · New York · Philadelphia · Washington · Buffalo · Cleveland · Detroit · Chicago · St. Louis
Cincinnati · St. Paul · Salt Lake City · Pittsburgh · Kansas City · Denver · Seattle · Portland · Los Angeles
Houston · New Orleans · Atlanta · Memphis · Tulsa

BOILERS · PULVERIZERS · BURNERS · STOKERS · SUPERHEATERS · FLUE GAS SCRUBBERS

traveling grate spreader stokers...

Riley Stoker Corporation has well over fifty years of stoker experience. Riley is also one of the oldest manufacturers of traveling grate stokers in the country. There is a world of stoker experience back of Riley Traveling Grate Spreader Stokers.





Furnace view of Riley Traveling Grate Stoker. Enlarged view shows travel of grate around rear of stoker.

These well-known companies have ordered Riley Traveling Grate Spreader Stokers

- Ohio Edison Company
  Iowa-Illinois Gas & Electric Co.
- Central Illinois Light Co.
  Otter Tail Power Co.
- Cliffs Power & Light Co.
  Carbide & Carbon Chemical Corp.
- Celanese Corp. of America
  Swift & Company
- Utica Knitting Co.
  Sangamo Electric Co.
- General Time Instrument Co.
  Stokely Foods, Inc.
- Armstrong Cork Co.
  Kaiser-Frazer Corp.
- Minnkota Power Co-operative
  General Fireproofing
- City of Provo, Utah
  City of Eugene, Oregon
- City of Ames, Iowa
  University of Minnesota

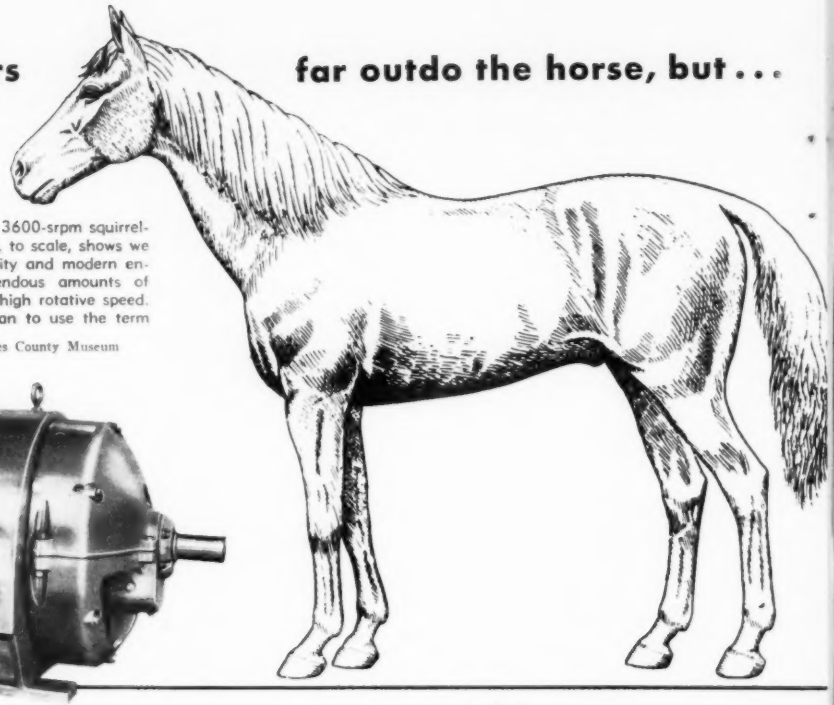
A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

ECONOMIZERS · WATER-COOLED FURNACES · STEEL-CLAD INSULATED SETTINGS · AIR HEATERS

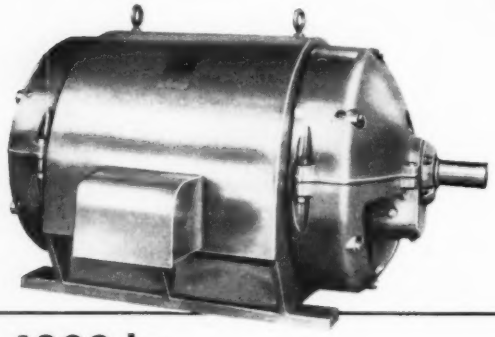
. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

Modern motors **far outdo the horse, but . . .**



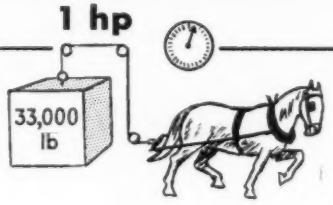
COMPARISON between modern 3600-srpm squirrel-cage induction motor and horse, to scale, shows we have come a long way. Electricity and modern engineering make possible tremendous amounts of "horsepower" in small units of high rotative speed. This article traces how we began to use the term

Drawing, courtesy of Los Angeles County Museum



1000 hp

1 hp



We Call It Horsepower . . .

in continuing tribute to the docile, enduring animal, streamlined for work, that first enlarged man's industrial power

By S P **BORDEAU**, *Electrical Engineer*
Electric Machinery Mfg Company

► "HORSEPOWER," as every engineer knows, is not the straining at the collar of our well-regarded four-legged friend, but a definite unit of the rate of doing work. We call this measure horsepower, but is it not odd, in a world of electricity, atomic power and supersonic planes, that we should still envision power in terms of horses? Quite a tribute to "Old Dobbin" that no one has figured a better way, and a good case for our preference for concepts we can readily picture.

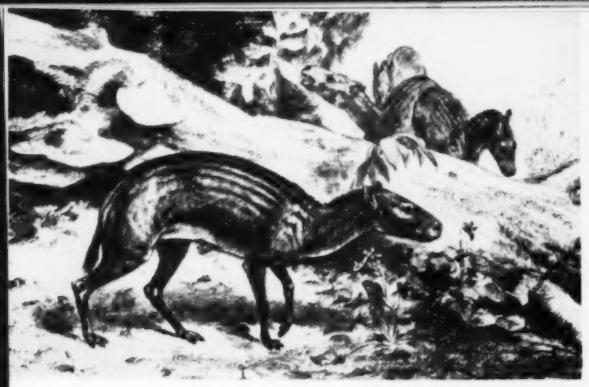
The present-day buyer of a 10-hp engine, or a 1000-hp electric motor like that shown above, knows just what work he can expect from his investment. This definite, measurable guarantee is essential to modern industrial practice. But why does the buyer specify his engine or motor by horsepower and how does he know what he is getting? For the answer we must turn to the history of the horse and the steam engine.

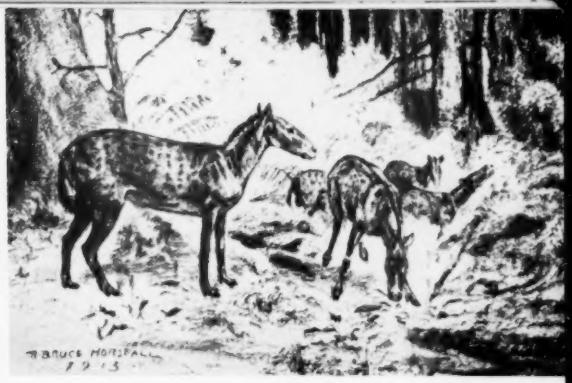
Industrial Milestone. Lost somewhere in the mists of antiquity is the record of the first man who enlarged his own power by harnessing an animal. But wherever it was, it marked a milestone in our industrial age. By multiplying his own muscular power, man achieved a first long step to greater production.

Among the animals that have been used for power are the horse, camel, elephant, dog and ox. Why then do we not use, say, "oxpower" instead of horsepower for the rate of doing work? The reason lies mostly in the evolution of the horse, a grass-powered engine. Over a period of millions of years, according to geologists, it went through a specialized change in structure to adapt for survival by a remarkable combination of power and speed.

Enduring, docile and streamlined for work, the horse in harness was a natural choice for pulling loads and powering primitive mills. So when James Watt in 1780 first put steam effectively in harness, he had only to look around him to see what power his engines would replace.

So long as Watt's first units were direct-connected to plunger pumps for raising water from mines it was sufficient to rate them simply by cylinder diameter, length and number of strokes. This could be translated directly into pumping output. But when the engine spun a wheel and delivered rotative

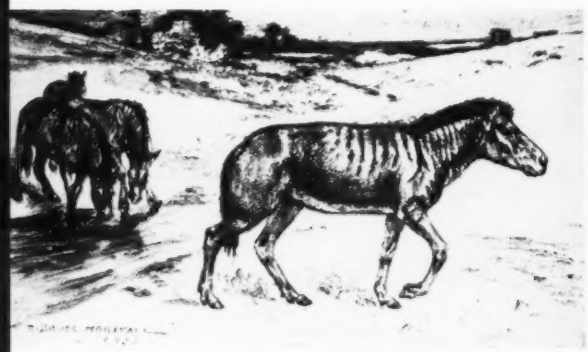




Development of the modern horse took 50 million years . . .

DAWN HORSE (Eohippus): This earliest known ancestor was a little fellow, standing 12 in. high at the shoulder, size of a small dog. Roaming Wyoming's lush plains 50 million years ago, he had five toes in front, each tipped with a tiny hoof

MIDDLE HORSE (Mesohippus): By Oligocene time, 30 million years ago, the horse began to look more like he is today. He had evolved in size to that of a sheep, had only three toes, the middle toe being distinctly bigger with an enlarged hoof



. . . it is Nature's most skillful evolution for speed and power

NEW HORSE (Neohipparion): Here is the horse of some five million years ago. Now as big as a small pony, he walks up on his middle toenail, outer toes no longer on the ground. Greater running speed comes from his longer stilt-like shanks

WESTERN HORSE (Equus occidentalis): This horse, single-toed, once lived by the millions in North America, then mysteriously became totally extinct here. Modern horses were introduced in America by Spanish explorers of 16th century

Pictures from *History of Land Mammals of the Western Hemisphere*, by W B Scott, copyright 1937 by American Philosophical Society and used by permission of The Macmillan Co

power it became of little use to tell the user the cylinder size.

A new method to express power had to be devised and the inventive Watt quickly met the situation. To guide him he had information on how many horses could do the work his engine must do. Thus, the engine's capacity could be expressed nicely in terms of the number of horses it would replace.

Horsepower Standard. Enthusiastic, like most inventors, James Watt selected no ordinary nags for his horsepower standard. Rather, he experimented with the sleek, strong Percherons drawing London's heavily laden brewer's wagons. Having them pull a variety of weights up out of a well over a roller with little friction, he first figured that a horse could raise 180 lb when moving at 180 fpm, or about 2 miles per hr. This gave 180x180 or 32,400 ftlb per min. Later, in 1783, after further experiments, he simply evened the figure to 33,000, and in the *Edinburgh Review* for January 1809 the standard of horsepower was defined for the first time. It was formally stated as the work done in raising 33,000 lb one ft high in one minute.

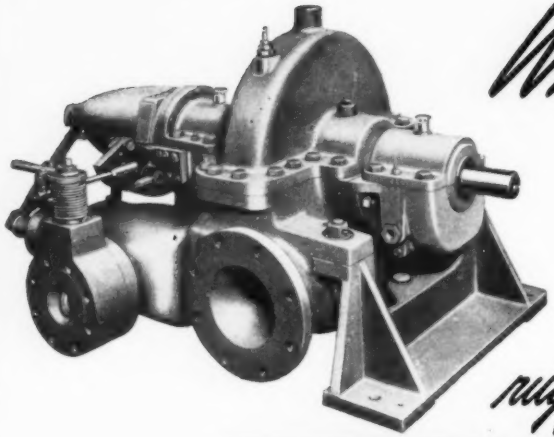
Although it is known that a horse cannot work continuously at the standard so set, Watt's figure has never been modified. Down through the years it became firmly established as the power-quantity reference and his exact formulation of this unit was a tremendous forward step.

Since Watt's time the power of steam has been vastly enlarged and made incomparably more adaptable and useful by conversion to the power of electricity. Electric motors have the unique advantage of providing concentrated rotative power at the job in economical, compact, easily installed and adaptable form, at any size or speed.

The motor shown, for example, delivers 1000 hp at about 3550 rpm. To do this, the motor must exert a continous turning effort, or torque, of 33,000 x hp ÷ 2 π x rpm at a one-ft radius, or 1480 ftlb.

Power of 1000 Horses. Matched with the motor in a tug of war, one of James Watt's powerful brewery horses might momentarily equal this pull. But Watt in his most inspired moments could not have dreamed how, in the hands of today's electrical engineers, the concen-

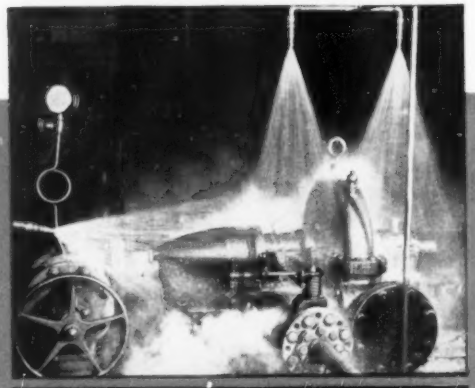
(*Continued on page* 172)



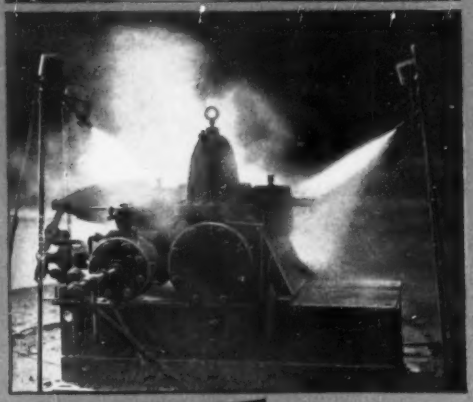
Where there's NO

COUNT ON

rugged · reliable · economical



Water-test periods running for hours and hours—with turbine operating and standing still—prove the effectiveness of *Type L* bearing seals against water contamination of the lubricating oil.



Dust-like, hard abrasive sprayed on the *Type L* operating at full speed . . . none of the abrasive entered the bearing housing—governing and overspeed mechanisms operated freely.

DUAL PROTECTION . . .

provides a double line of defense against overspeed. If speed should become excessive, Dual Protection positively shuts off the steam flow by tripping the governor valve and a rugged butterfly valve simultaneously.

WEATHER PROTECTION . . .

Exposure to all conditions—water, dust, and other foreign matter, outdoors or indoors . . . will not impair the operation of *Type L* turbines.

CENTERLINE SUPPORT . . .

The *Type L* method of support allows freedom of expansion and contraction of the casing without disturbing the alignment of the rotor shaft. The casing is positioned at the exhaust end by a kingpin which transmits pipe thrust to the foundation. A flexible channel-beam at the governor end allows for axial expansion.

RUGGED GOVERNOR HOUSING . . .

completely protects the governor assembly and shaft end. The housing is exceptionally strong and will withstand the abuse small turbines sometimes receive.

• • •

Get all the facts! Call your nearest Westinghouse office or write for Booklet B-3896, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh, 30, Pennsylvania. J-30487-A

SAVE ON SPARE PARTS

Interchangeability of parts between units—even between frame sizes—cuts down your investment in "spares". For example, the entire shaft-governor assembly can be removed from one unit and installed on another, without disturbing the rotors.

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

TIME FOR "TIME OUT"

TYPE E GENERAL-PURPOSE TURBINES

Here's the mechanical drive turbine built to give trouble-free, economical performance for long periods of continuous operation . . . or to assure instant operation as a stand-by drive.

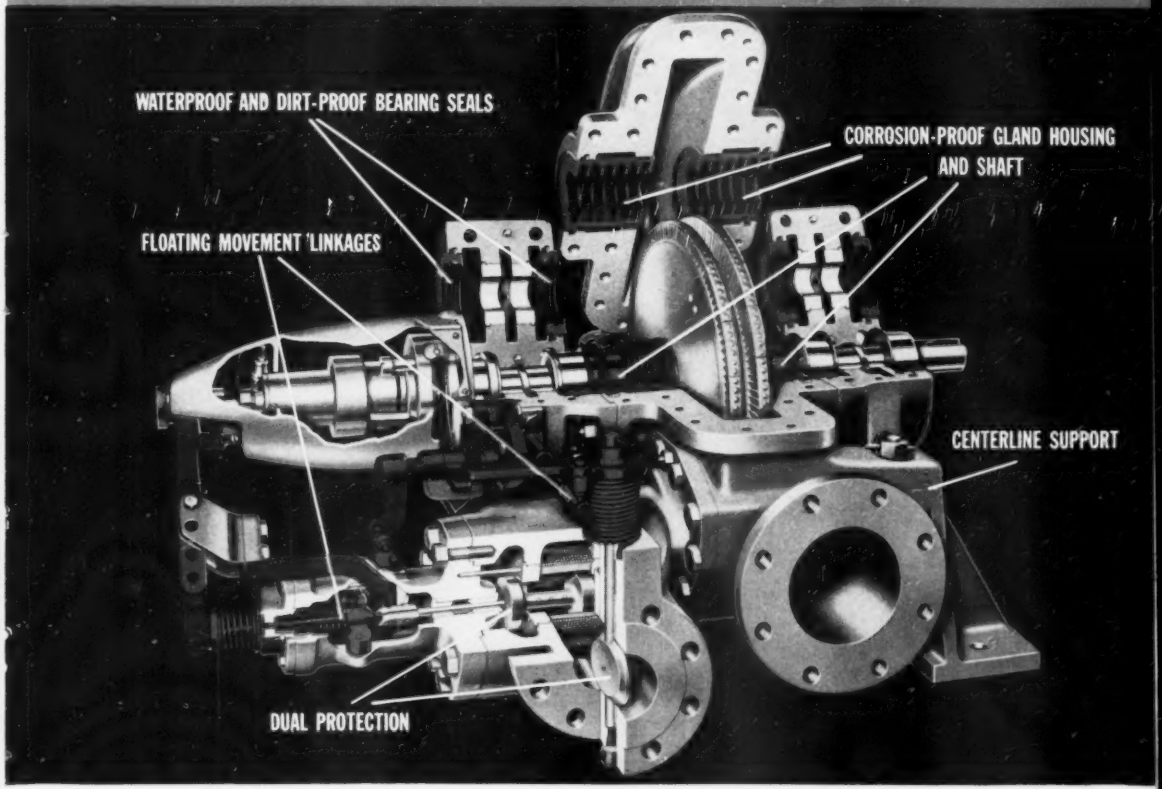
Outstanding features "built in" TYPE E for protection against overspeed, corrosion, misalignment, and interference of operation by water or dirt include: weatherproof bearing seals, corrosion-resisting gland zones, centerline support, Dual Protection against overspeed, floating movement of governing and trip linkages, and parts interchangeability.

Years of experience in building all types of turbines, and "millions of horsepower" of general-purpose turbines . . . plus specialized knowledge of application engineering—are some of the factors that have gone into the TYPE E turbine design and construction.

Get the facts. Call your nearest Westinghouse office for booklet B-3896, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

YOU CAN BE SURE... IF IT'S Westinghouse

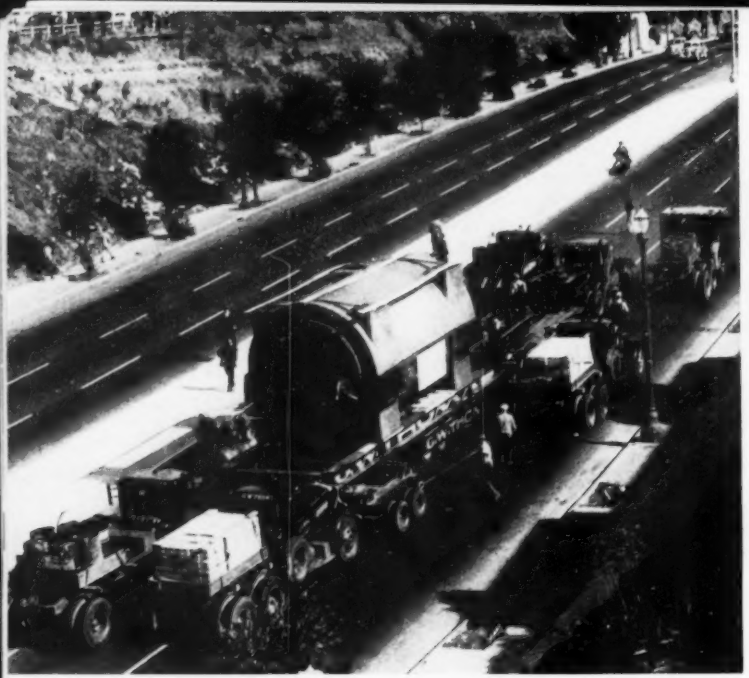
CHECK THESE FEATURES!



Steam Headquarters

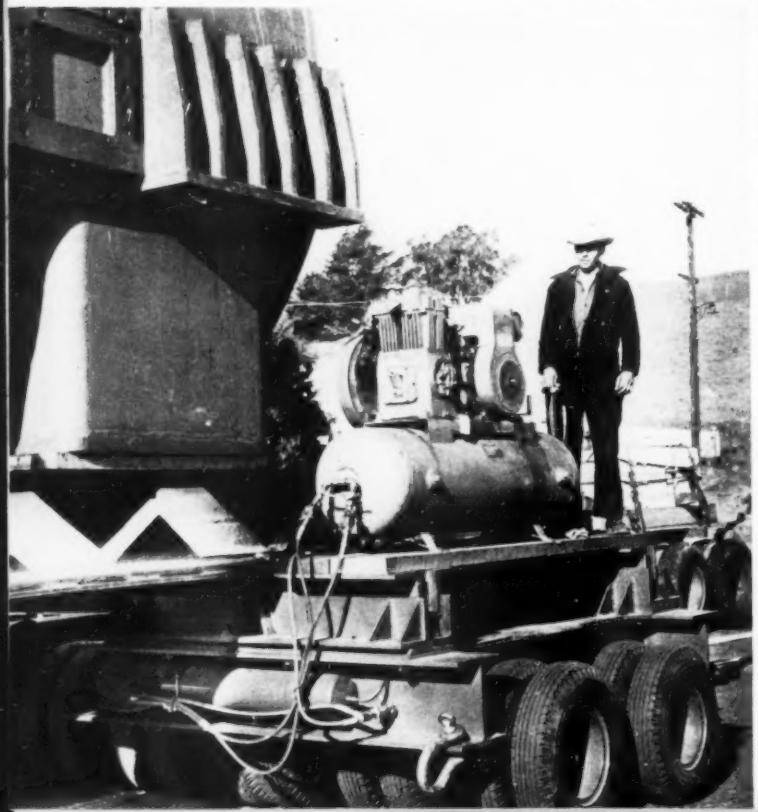
WESTINGHOUSE

100,000-kw Generator Takes a Buggy Ride



TURBINE-GENERATOR armature is being moved uphill on Bayshore Highway in San Francisco. The five trucks pulling and two pushing have a total of over 1000 hp

SPECIAL AIR COMPRESSOR, mounted on rear of trailer with brakeman at control, supplies air brakes on vehicle loaded with 100,000-kw turbine-generator stator



► THE SECOND of two GE 3600-rpm 100,000-kw turbine-generators, for Pacific Gas and Electric Co's Station P in San Francisco, has been delivered. Expansion of this station is part of the huge postwar program the utility is carrying on to furnish power to bustling northern and central California.

Shipping the first of the two units set a record as one of the largest single shipments of freight ever recorded. The gigantic stators, largest pieces of the installation, weigh more than 355,000 lb each. To ship them, a special freight car was built with 8 axles and 16 wheels as compared with the usual 4 axles and 8 wheels. Roundabout routing was necessary because of weight limitations and clearances along the regularly traveled cross-country tracks.

Huge Stators. When the generators arrived in San Francisco, five days were required to transfer each stator from its freight car to a 74-wheel 14-ply rubber-tired trailer built by the Thomas Drayage Co.

Moving the load up some of the hills required 7 trucks, 5 pulling and 2 pushing, whose power ratings totaled more than 1000 hp. To assist in braking the stator down one steep highway, it was necessary to mount a motor-driven winch at the top of the hill. A special air compressor was mounted on the trailer's rear section to supply air to the brakes.

Even though there is a direct railroad siding into the power station, trucks had to haul the load through the city because tunnels along the rail route were not big enough to let the stators through.

"Give us the tools . . ."

McGraw-Hill Surveys BUSINESS NEEDS

If it can get the money American industry in 1949 will go full steam ahead with a vitally-needed program of improving its facilities. This program since V-J Day has kept business expanding and has made belated headway in modernizing industry.

Furthermore, if it can get the money American industry will carry on for the next five years with its unprecedented program of expenditure for new plant and equipment. Plans already made call for spending about $55 billion.

These are findings of the McGraw-Hill national survey of "Business' Needs for New Plants and Equipment." Major results of the survey, which have been rechecked since election day, are summarized on the following page. They report what American industry is now planning to spend for new plant and equipment. *They do not and cannot show what will be done if the plans are hamstrung by political action.*

In 1949, the survey shows, American industry plans to spend $14.1 billion for new plants and equipment. That is only about 5% less than was actually spent in 1948.

If these plans are carried out, actual capital expenditures this year may be somewhat larger than they were in 1948. That is because expenditures usually prove to be larger than planned.

Fulfillment of American industry's plans for investment in new plant and equipment this year would no doubt mean a continuation of general prosperity. The record shows that when capital expenditures are high general business thrives.

Even more remarkable than the 1949 prospect is the fact that:

Industry already plans to spend $41 billion in the years 1950-53 to improve its plants and equipment.

Plans tend to taper off, of course, as they are pushed further into the uncertain future, five years from now. But the striking fact is that plans for expenditures so far ahead are as great as they are. They show American industry's need for tremendous improvements in its plants and equipment.

Again, let there be no mistake. These survey findings are not a five-year forecast. They report what leading corporations now are planning to do – *if they can get the money.*

But – won't industry be top-heavy with plants and equipment if it carries through any such program?

The answer is clearly – "No".

Here are some of the reasons why not that were disclosed by the McGraw-Hill survey:

First, manufacturing industries are shifting emphasis from expansion to improving efficiency.

They have increased their total capacity 56% since 1939. Their expenditures in 1948 went almost 50-50 for expansion and improvement. But in the next five years they plan to spend three-quarters of their funds to replace and modernize facilities, only one-quarter for expansion.

Second, the prospective rate of expenditure for new plant and equipment is relatively low.

Planned expenditures for new plant and equipment in 1949 represent about 7.5% of the present value of all plant and equipment. That rate of capital expenditure is no higher than the rate during previous periods of prosperity. And industry must overcome years of starvation for new equipment, caused first by the depression of the 30's, then by diversion to war production.

Third, industry is following an extremely cautious policy in buying new equipment.

Three out of four companies report that they will not buy equipment unless it will pay for itself within five years. And a third of the companies report that they expect new equipment to pay for itself within three years. The reason most frequently given for such expectations was that all the money available can be spent on equipment which does pay for itself quickly.

The program of capital expenditure planned by American industry is one of the greatest bargains ever offered to the American people.

To pay for itself in a few years, as equipment must if most companies are to consider buying it, that equipment

continued on next page

WHAT THE SURVEY SHOWS

● HERE ARE THE MAJOR FINDINGS of McGraw-Hill's survey of "Business' Needs for New Plants and Equipment". Rechecked since Election Day, results show what industry is now *planning* to spend for new plants and equipment. They do not forecast what will actually be spent. The survey shows:

1. Industry now plans to spend $14.1 billion in 1949 – and almost $41 billion in the four years beyond, 1950-53.
2. Manufacturing industries alone plan to spend $7.2 billion in 1949. This is 7.5% of the estimated value – $96 billion – of all manufacturing facilities.
3. Manufacturers estimate conservatively that it would cost $136 billion to completely replace their facilities with the most modern plants and equipment available.
4. Postwar expansion is virtually complete in most manufacturing lines. Major exceptions: steel and petroleum refining.
5. Expansion programs of railroads, utilities, and oil companies still have two to five years to run.
6. Manufacturing industries have increased their capacity 56% since 1939. But expansion is slowing down. Increase planned in the next five years is only 13%.
7. Efficiency is emphasized more and more in planning new facilities. Manufacturers plan to devote almost three-quarters of their funds to replace and modernize. In 1948, 58% went to increase efficiency this way.
8. Equipment should pay for itself in five years or less, say three out of four manufacturing companies. New buildings, say 77% of them, should pay out in 15 years or less.
9. Profits and reserves are counted on to pay for new buildings and equipment by three out of four manufacturing companies. Some 15% expect to borrow, only 9% plan to sell stock. However, 20% would like to sell stock, only 4% want to borrow.
10. More liberal depreciation allowances for income tax purposes would prompt almost two-thirds of the companies to speed their purchase of new plants and equipment.

● A copy of a complete report on "Business' Needs for New Plants and Equipment" may be obtained by writing me at McGraw-Hill Publishing Co., 330 West 42nd St., New York 18, N. Y.

must promise to produce much better products or make great savings in labor and material. The savings go first to the companies buying the equipment but, as they always have, they soon spread to everyone in the form of better products at lower costs.

Where does industry expect to get the money to buy this bargain for the American people?

Most of the companies covered by the McGraw-Hill survey (76% of the total) count on their own resources – largely profits – to pay for new plant and equipment. About 15% of them expect to borrow money, although only 4% like the idea of getting saddled with fixed debt. Only 9% of the companies expect to sell stock to investors, although twice that many report they wish they could.

What are the chances that business can get the money?

The survey provides no answer to that question. No survey can.

The answer will come from Washington – in what Congress does about taxes on profits and taxes on the millions of Americans who might invest a part of their income in industry's new plants and equipment.

The answer will be found also in the energy and skill shown by investment bankers, particularly in mobilizing the resources of the millions of Americans whose incomes have increased enough since 1940 to make them potential direct investors in industry.

Still another important part of the answer will be given by labor leaders. About half the companies surveyed by McGraw-Hill are holding back on new construction – primarily because of high costs. What organized labor does about wages and productivity can swell or shrink that percentage.

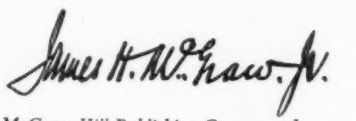
The McGraw-Hill survey leaves no doubt that American industry is fulfilling its responsibility. It is planning the capital improvements needed to make the nation secure, prosperous, and progressive.

But business today lacks confidence and badly needs added incentives. Proper taxation and increased depreciation allowances are vital if we are to open the capital markets to finance industry.

What will happen now depends in large part on what is done in Washington. In his State of the Union message, the President said that "business should plan for steady, vigorous expansion." But in his budget message he proposed new taxes which would divert a substantial share of the money industry is using for expansion and improvement. Moreover, he said nothing about the vital issues now freezing the capital markets.

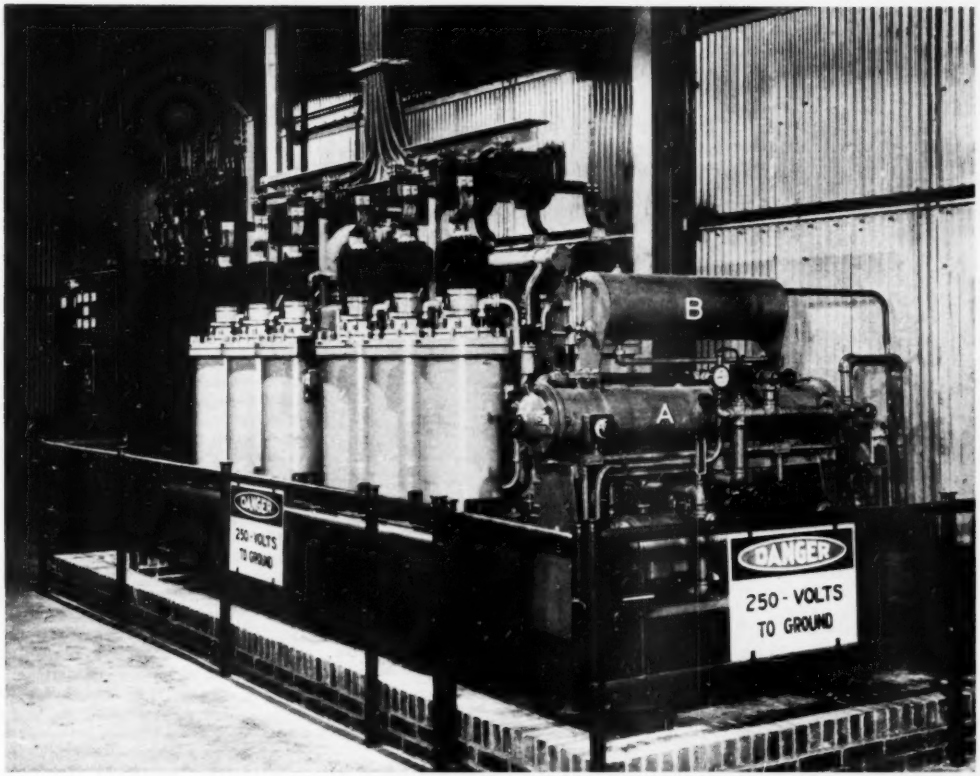
It is not possible to have it both ways. Fulfillment of the President's tax program means cutting industry's program for new and better equipment. It means slowing down industrial progress. It means delaying the advance toward much higher standards of living tomorrow in order to have a little more government spending today.

I urge you to see that your Representative and your Senator have all the facts on industry's needs for new plant and equipment. What they do to this program will have a decisive bearing on the nation's security and welfare.



President, McGraw-Hill Publishing Company, Inc.

This is the fourth editorial of a special series on industry's needs for new plants and equipment – and what these needs mean to all Americans.



1 Twelve-tank 1000-kw mercury-arc rectifier supplies 250-volt direct-current power to the load for a steel mill. The water-to-water heat exchanger with automatic temperature control is shown at right, with expansion tank above

These Operating Practices Keep Mercury-Arc Rectifiers on the Job

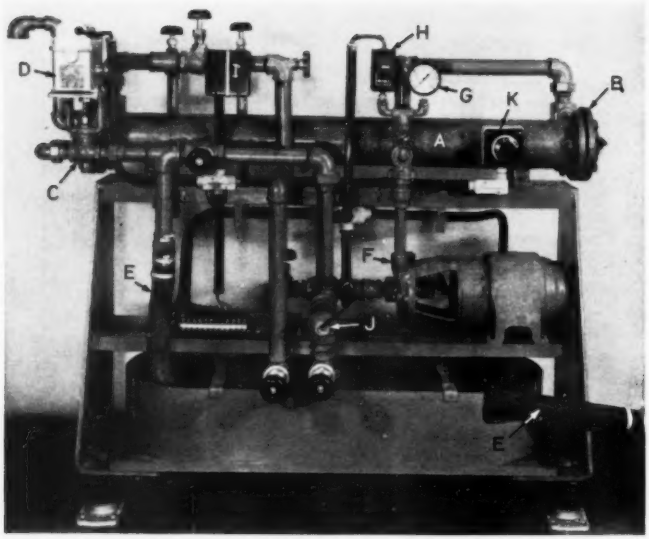
Keeping the heat exchanger on a mercury-arc rectifier in good condition is a must for successful operation. Here are field-tested practices that will insure long and trouble-free service

By S R DURAND
Engineer, Pacific Zone
Allis-Chalmers Mfg Co

► MERCURY-ARC RECTIFIERS supply dc power to steel mills, industrial and electrochemical plants, mines and traction systems. To dissipate heat produced by the arcs in these rectifiers a cooling system is required to keep the mercury-vapor temperature and pressure within operating limits.

High-power steel-tank mercury-pool rectifiers are built with jackets or coils through which water is circulated for cooling purposes. A water-to-water or water-to-air heat exchanger is generally used in the cooling system to avoid corrosion of rectifier cooling coils and to economize in water and power.

Cooling Systems. Fig. 3 diagrams a cooling system for a 6-phase excitron rectifier. Each rectifier tank has an insulated internal-cooling coil of large surface, near the arc, that condenses the mercury vapor. The unit's six tanks have their cooling-coil circuits connected in parallel to inlet and outlet



2 A water-to-water heat exchanger unit has the heat-exchanger cylinder, as shown at A, mounted horizontally on top of a frame that is insulated from the ground

pipes in the rectifier frame, as indicated. A water-to-water heat exchanger with circulating-water pump and control devices is assembled on a separate frame and installed near the rectifier. In recent practice it is installed on the rectifier frame. Connections between cooling equipment and rectifier are made by rubber hose or insulating pipe.

Fig. 2 is a water-to-water heat exchanger unit with the heat-exchanger cylinder mounted horizontally on top of frame. Heat-exchanger cylinder *A* contains a bundle of corrosion-resistant alloy tubes connected in parallel between headers *B* at each end of the cast-iron shell. Water flow through the tubes is automatically regulated by a motor-operated valve in the fresh-water supply line. Valve *C* and operator *D* are mounted near left-hand end of heat-exchanger cylinder, and connected to water supply through an insulating hose *E*. Fresh-water flow through the tubes absorbs heat from water in the closed system that passes through the cylindrical shell and is directed across the tubes by a series of baffle plates as indicated, Fig. 3.

A motor-driven centrifugal pump *F* circulates the closed-system water at a constant rate. A pressure gage *G* and pressure relay *H* are above the pump. A modulating thermostat *I* controls circulated-water temperature to a maximum of about 131 F (55 C).

This thermostat positions the motor-operated valve to regulate water required for heat exchange between the two systems. Fresh-water flow depends on rectifier load. Light loads may need only a few gallons per minute, whereas full load or overload of large rectifiers may require as much as 50 gpm.

Another thermostat *J* closes its contacts on over-temperature to actuate an annunciator alarm or protective equipment. Snap switch *K* is used for testing and flushing to run the motor-operated valve to full-open or closed position.

Rectifier, Fig. 1, has its heat exchanger *A* in foreground. A water expansion tank *B* with sight gage is mounted on top of its cylinder instead of on the rectifier unit because anode connections were brought in from above. Expansion tank must be higher than any other part of the closed water circuit. In unheated buildings, immersion heaters are installed in the closed circuit to hold the water temperature automatically above 95 F (35 C) during idle or light-load periods.

In water-to-air heat-exchange systems, a duplex water valve often regulates water flow in the fan-cooled radiator proportional to the amount circulated through the rectifier. Water cooled in the radiator is mixed with the water passed through the rectifier to hold a constant outlet-water temperature irrespective of load variations. Only under heaviest loading will all water pass through the fan-cooled radiator, which may be located away from the rectifier on the substation roof.

Maintenance. Water-to-water or water-to-air heat-exchange systems have high reliability and normally require little attention. But because proper cooling is vitally important for satisfactory rectifier performance, cooling equipment must be given periodic attention.

Two rubber gaskets and brass-ring seals between the headers and shell of the heat-exchanger cylinder prevent mixing the water in the two systems. If a leak develops, water flows through telltale holes in the brass ring and is found under the flange joint. Also, water level in the sight gage of the expansion tank, rising or falling more than normal, indicates a possible leak. Tightening the flange joints usually stops such a leak. If this measure is not effective, remove the headers and replace defective gaskets.

In a closed system treat the water with a strong oxidizer to prevent corrosion. A 0.5% solution of sodium chromate, Na_2CrO_4 is generally used because it forms a resistant film of iron and chromium oxides on metal surfaces. A concentration of about 0.66 oz of sodium chromate per gallon of water is satisfactory. Have the solution's pH value about 8.5. Test the concentration of the sodium chromate in the cooling water to determine if it is adequate to prevent corrosion. Once a year replace the solution with a new supply having a proper strength of dissolved sodium chromate. If a good soft water is not available, use distilled water, with which a 0.1% solution of anhydrous sodium chromate is adequate.

To determine pH value take a sample of about 15 cc of the treated water in a graduate and add a few drops of phenolphthalein indicator. Solution turns pink when the pH value exceeds 8.2. Sodium-chromate solutions leave stains so handle them carefully. When treating water for refilling a closed system, first determine amount of water and weight of sodium chromate needed. Then dissolve the sodium chromate in about a gallon of hot water before adding it to clear water previously placed in the system.

Water pump and valve stems have packed glands to prevent leakage. If a small amount of leakage occurs, tightening the packing usually stops it. If it becomes excessive and cannot be stopped by tightening, it is best to replace the packing rather than add treated water frequently to the closed system.

When fresh water for cooling contains sand or sediment, flush out the heat-exchanger tubes periodically by flowing the maximum amount of water

through them. This can be done by throwing the small snap switch from automatic to manual control and running the valve to full-open position. When periodic flushing cannot remove sludge in tubes, remove headers and clean each tube by brushing.

Heat exchanger's efficiency is reduced when it accumulates deposits. This condition is evident when the rectifier's normal operating temperature cannot be held without an increased water flow. Amount of water required to maintain normal operating temperature in the rectifier is a good indicator of the necessary schedule for flushing the heat exchanger. Arrange for periodic attention to maintain a relatively high heat-transfer efficiency.

The frame on which modern single-anode rectifier tanks are assembled is at positive dc potential, and is supported on insulators to insulate it from ground. For practical reasons heat exchangers are also mounted on insulating feet, Fig. 2. Water circuits to both the rectifier frame and the fresh-water supply and drain are made with rubber hose or insulating pipe. By keeping the heat exchanger at floating potential, leakage current to ground is limited to such low values that electrolysis will not cause water fittings to be eaten away.

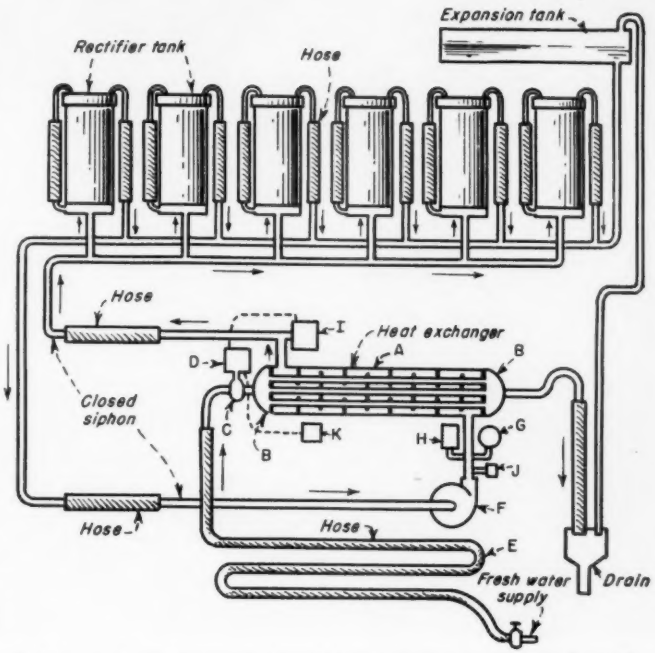
Fresh-water supply connection resistance is particularly important. To obtain sufficient length of hose for this circuit, it is usually coiled in an insulated section of the heat exchanger's base. Resistance value of several thousand ohms for this cold-water circuit is often about 30 times that of the shorter treated-water connections to the rectifier, so the fresh-water connection must be of adequate length to limit leakage current to a harmless value. Make sure the heat exchanger does not become grounded, and all electrical devices and wiring on it are properly insulated to operate at several hundred volts dc above ground potential. If an insulation failure is suspected disconnect the wiring and test for a ground with an ohmmeter.

Pressure gage serves as a visible indication of centrifugal-pump operation. The pressure relay sounds an annunciator alarm if the pump fails. In the water-outlet circuit of each rectifier tank an over-temperature thermostat opens a circuit breaker to disconnect the rectifier if a tank reaches an excessive temperature. These devices are highly reliable and failure of any one of its circuit wiring shuts down the rectifier. To avoid false operation, check the circuits occasionally and keep the devices, wiring and terminal blocks clean.

A water-to-air heat exchanger has several disadvantages when compared to the water-to-water type, and is used only when good cooling water cannot be obtained. Its initial cost is higher as is the operating cost for the fan motor. Space required is considerably greater and the fan motor's noise may be objectionable.

In hot weather, keep the radiator clean to maintain efficient heat transfer. In cold weather, antifreeze solutions must be used in many localities to prevent freezing the radiator, which is usually installed outdoors. Thorough cleaning (usually with chemicals) and repeated flushing is required when changing from sodium chromate to antifreeze solution, and vice versa.

Periodic inspection of rectifier-cooling systems is a good practice to maintain high heat-transfer efficiency and avoid failures at inopportune times. Preventive maintenance cost is more than repaid if this important auxiliary equipment gives trouble-free service essential for reliable operation of high-power mercury-arc rectifiers.

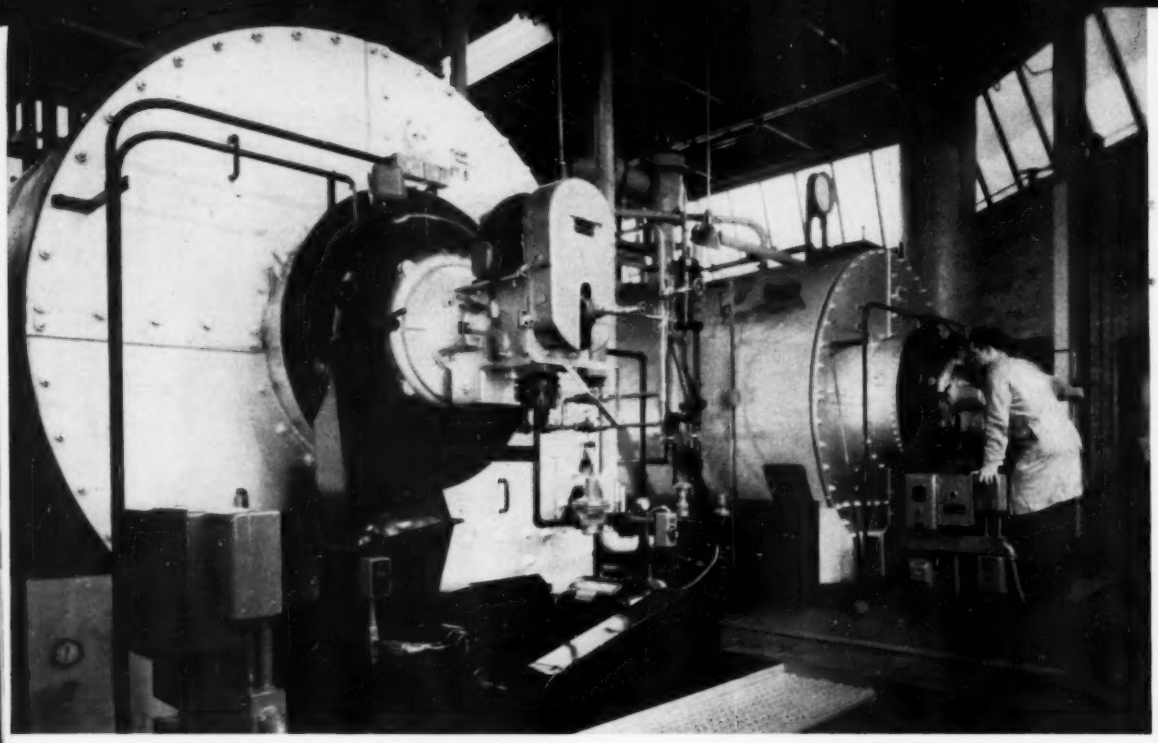


3 Diagram of a cooling system for a 6-phase excitron mercury-arc rectifier. The six rectifier tanks have circuits for the cooling coils connected in parallel

Ice in Overhead Water Tanks

In cold climates overhead water tanks must be heated to keep water above freezing. These tanks are rarely insulated. Therefore, the tank's shell becomes lined with ice, which may reach considerable thickness during cold spells. While this ice cuts down the volume of water slightly, it also reduces heat loss by forming an effective insulation. If water volume is critical, an oversize tank must be installed to compensate for the ice.

If an ice-laden tank is suddenly drained, there is always danger of large blocks of ice dropping off the sides and damaging the tank's bottom, or causing serious swaying of the tower. So inspect the tank at regular intervals throughout the winter, especially after cold spells. Break off any pieces of ice that accumulate. Also, be careful not to drain the tank during cold weather except in an emergency.—W. L. Govan, *Brantford, Ontario*



STEAM GENERATORS are of the packaged type, oil fired. Rated at 12,000 lb per hr each, either can handle normal plant load

Here's a Small Boiler Plant That

Combine modern equipment and methods in a convenient and accessible layout. Add careful attention to the details that make good operation easy. That's the recipe for a plant like The Jackson Box Co's—one that stacks up with big brothers

► THERE'S NO REAL REASON why a small plant can't be just as good as a large one if the same careful attention goes into its design. The boiler plant of The Jackson Box Co in Norwood, Cincinnati, shows what can be done by using modern equipment arranged with full consideration for effective and convenient operation and maintenance.

This plant makes corrugated paper, and cuts, folds and prints it for boxes and cartons. Electricity is purchased. Principal users of process steam are the two corrugating machines, with a much smaller amount going to glueing and taping operations and miscellaneous uses. Steam is also supplied to unit heaters and for hot service water.

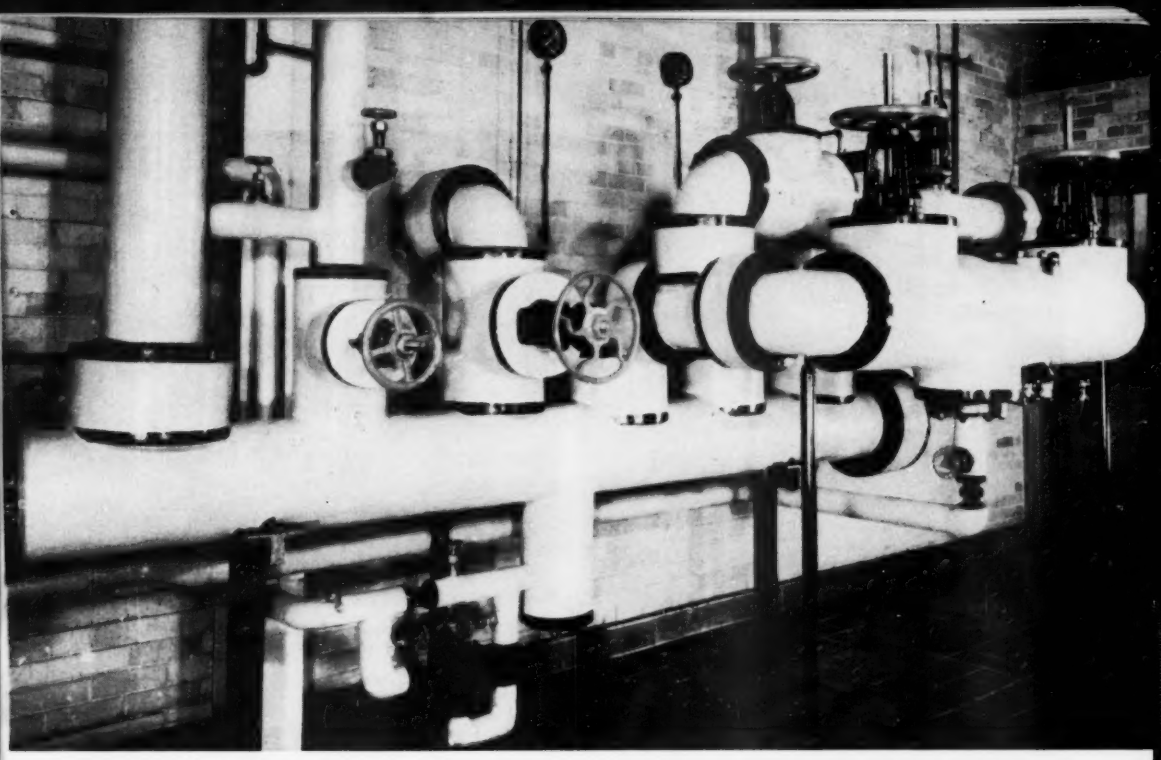
Formerly, steam demands were met from a coal-fired boiler house. Plant expansion and higher rates of production made the old units inadequate. Maintenance and operating-labor costs were high and the entire operation suffered from a variety of ills growing out of failure to plan the original installation soundly. Thus when the end of the war made it possible to rebuild, R T Cassady, vice-president in charge of operations, firmly resolved that the new plant would be designed to avoid the weaknesses of the old.

Model Plant. He achieved his objective and arrived at a plant that might well serve as a model for spacious layout, ample lighting and ventilation and provision for the comfort and convenience of operating personnel. This was accomplished without excessive cost by careful selection and arrangement of equipment and attention to details. There is no gingerbread or frills, but devices that will improve operation—boiler-water-sample coolers and embrittlement detectors, for example—are provided and, more important, used.

The new boiler house forms an extension to the existing plant building. Interior walls are faced with salt-glazed brick and floors are tile. A continuous band of steel sash around two sides of the room provides light and ventilation. Modern locker and shower-room facilities are installed at one side.

The two new oil-fired boilers are rated at 12,000 lb per hr; either unit can handle normal plant load. Operation is now on an 18-hr-per-day basis; during the heating season the boilers operate 24 hr.

Packaged Boilers. Steam-generating units are of packaged design, built by Cleaver-Brooks. The 4-pass internally fired boilers are mounted on a structural-steel base, which carries all firing and draft equipment, auxiliaries and controls. The Enterprise rotary-cup



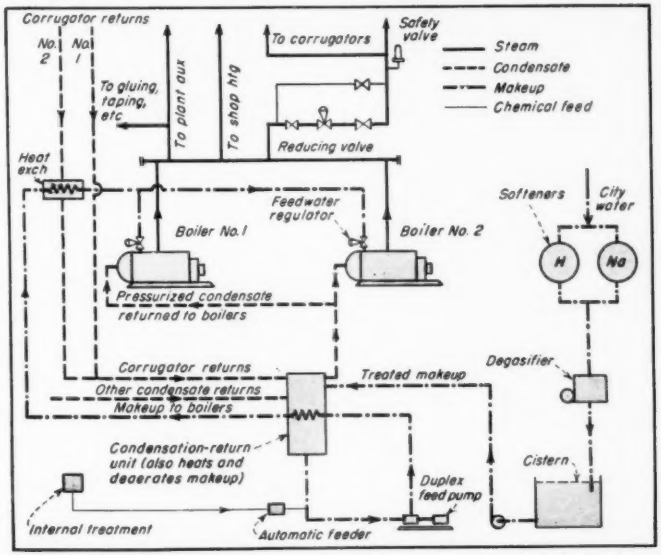
MAIN STEAM HEADER receives output of boilers, serves as distribution point for steam to process equipment, auxiliaries

Doesn't Need to Make Any Apologies

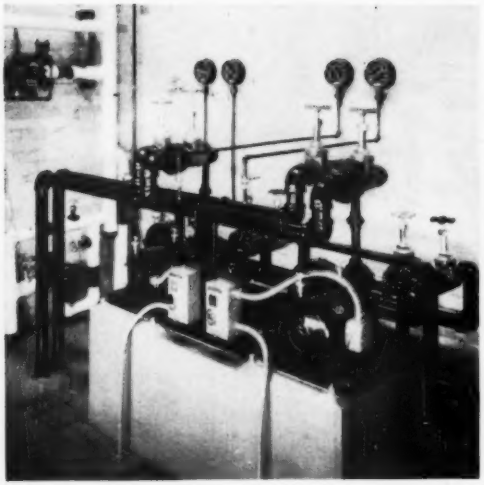
burners operate on the high- and low-fire system actuated from steam pressure by Manning, Maxwell & Moore pressuretrols, with Wheelco flame-failure protection. The usual relief-valve and strainer hookup is provided. All draft requirements are met by a single forced-draft fan driven by a constant-speed motor. Control is by damper. Flue gas discharges into stub stacks rising about 15 ft above the roof.

Steam Distribution. Output from the boilers goes to a common header along the rear wall (see photo above and diagram at right). Average operating pressure is 155 psi with boiler safeties set for 185. Steam for the corrugators is controlled at 150 psi by a Spence reducing valve in the branch serving these machines. Another branch from the header supplies glue machines, taping units and other small process uses, as well as boiler-plant auxiliaries. A separate line with a Spence reducer to drop pressure to 75-80 psi, supplies new Modine unit heaters in the plant and a hot-water heater.

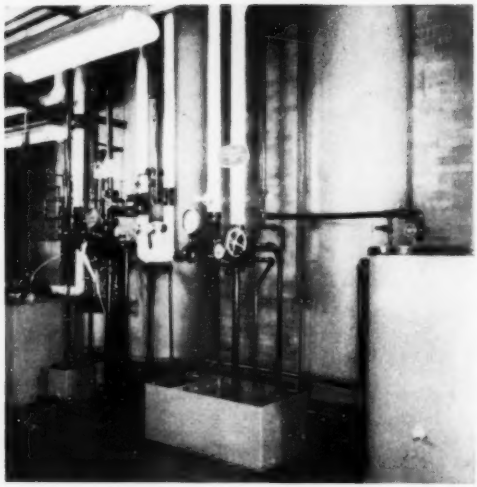
Bunker-C fuel oil, which comes to the plant by tank car and by truck, is stored



SIMPLIFIED DIAGRAM shows main distribution of steam output, also method of handling returns direct to boiler without traps and heating and deaerating makeup water



FUEL-OIL PUMPS supply rotary-cup burners on the boilers. Bunker C oil, received by car or truck, is stored underground



WATER TREATMENT employs hydrogen (left), sodium (right) zeolite softeners. Part of salt tank appears at lower right

underground in two 15,000-gal. tanks fitted with steam-heating coils. Two Viking oil pumps (see photo above) supply oil to the burners. Preheaters, which are part of the standard equipment of the steam generators, maintain the oil at proper viscosity for good combustion.

Water Treatment. The provisions for water treatment form a good example of the care with which this plant was designed. While there is nothing unusual about the system, it is thoroughly modern and well adapted to its task of insuring reliable boiler operation. About 80% of the boiler output returns as condensate, makeup being supplied from city-water mains. All treatment is carried out on the makeup (see diagram on preceding page).

The city water, which comes from wells, runs fairly high in alkalinity, hardness and sulphate, as the following typical analysis indicates:

	ppm	*gpg*
Turbidity	10	0.6
Free CO_2	16	1.0
Total alkalinity	343	20.0
Incrustants	40	2.3
Total hardness	383	22.3
Magnesium	22	1.3
Iron	2.2	0.13
Sulphate (SO_4)	41	2.4
Chloride	15	0.9
Calcium	103	6.0
Total solids	425	34.9

These constituents are probably combined as follows:

	ppm	*gpg*
$CaCO_3$	258	15.1
$MgCO_3$	71	4.2
$MgSO_4$	10	0.6
Na_2SO_4	49	2.9
NaCl	25	1.5

As can be seen in the diagram, raw makeup water flows through parallel hydrogen and sodium zeolite softeners in proportions determined by raw-water conditions. Blend of two softeners is usually set to produce approximately 15 to 30 ppm excess alkalinity, from which a boiler water pH from 10.5 to 11.0 is maintained. The sodium zeolite unit and salt tank come from the previous plant; the new hydrogen-zeolite unit, and the degasifier through which the combined effluent of the softeners flows, were furnished by Liquid Conditioning Corp. Treated water goes to cistern from which it is pumped by a Worthington centrifugal. A float switch actuated by cistern level controls operation of softeners and degasifier blower.

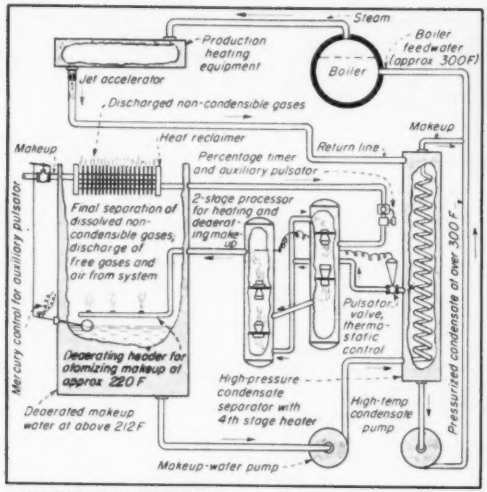
Internal treatment is supplied at the feed-pump suction by a Dearborn automatic intermittent chemical feeder. Boiler blowdown is handled continuously by a P E Madden Co system, with discharge to an underground blowdown tank and the sewer.

Regular Tests. Water tests are made regularly, using a Dearborn test kit. Each of the boilers is provided with a sample cooler to make it easy to obtain proper water samples. As an additional check on the effectiveness of water conditioning, boilers are fitted with embrittlement detectors.

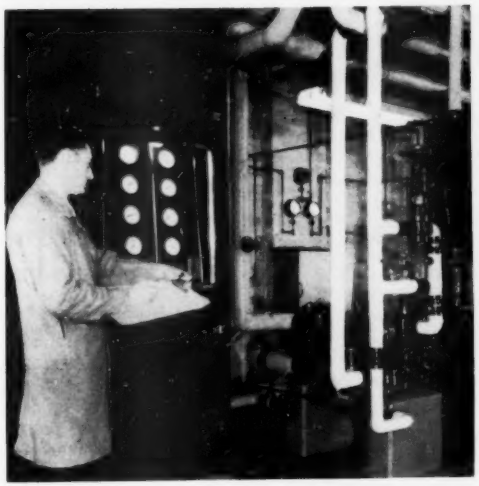
Condensate and makeup are handled by an integrated system which automatically balances return of condensate with the heat load in production equipment. At the same time, this patented system initiates and maintains a surging or pulsating action claimed to improve heat transfer in the production equipment. The system, furnished by Velocity Steam Production Engineering, Inc, is diagrammed on the facing page and, although it is plant-wide in its operation, equipment shown in the diagram is enclosed in the cabinet at the left of the adjacent photo. Gages on the panel board indicate conditions throughout the steam system.

Condensate Return. As shown in the general steam-flow diagram on the preceding page, external connections for condensate return are slightly different in this plant. Production heating equipment connects directly to unit receiving condensate. On return side of each steam chest there is a restricted area sized in accordance with the capacity of the equipment being drained. Through this passes condensate plus a certain amount of steam. Mixing in this restricted zone produces a wet-steam mixture in the return line.

Returns enter a high-pressure condensate separator through which makeup water flows in tubes. Cooling action of the makeup water condenses part of the steam; a high-temperature condensate pump takes its suction from this


Steam
Production heating equipment
Boiler feedwater (approx 300F)
Boiler
Jet accelerator
Discharged non-condensible gases
Makeup
Heat reclaimer
Return line
Makeup
Percentage timer and auxiliary pulsator
Mercury control for auxiliary pulsator
Final separation of dissolved non-condensible gases, discharge of free gases and air from system
2-stage processor for heating and deaerating make-up
Pulsator valve, thermostatic control
Deaerating header for atomizing makeup at approx 220 F
High-pressure condensate separator with 4th stage heater
High-temp condensate pump
Pressurized condensate at over 300 F
Deaerated makeup water at above 212F
Makeup-water pump

CONDENSATION RETURN is handled by an integrated system. Equipment diagrammed is housed in cabinet, left, next photo



BOILER FEEDING is handled by units shown: pump in cabinet returns heated condensate, duplex pumps (right) feed makeup

separator. An intermittently operated valve draws off the rest of the return-line steam for preparing makeup water in cycle to be described next. With this "pulsator" valve closed, the return circuit, from heating equipment back to the boiler, is at close to boiler pressure.

Makeup Cycle. Makeup water enters the condensation-return unit under control of a float-operated valve. It passes through a heat reclaimer, which acts as a vent condenser on the deaerator section of the unit and then goes to what amounts to a 2-stage direct heater. This heater, as can be seen in the diagram, receives steam from the condensate separator through the intermittently operated valve. Mixing of this steam with the makeup water raises its temperature to about 225 F. Makeup then goes to a spray header where it flashes for separation of dissolved non-condensable gases and discharge of free air and gases. A tank section below the header stores heated and deaerated makeup water; the discharged non-condensables give up heat to the incoming makeup in the heat reclaimer or vent condenser.

A pump draws water from this tank and discharges it through the tubular elements of the high-pressure condensate separator for further heating before it joins the main condensate flow. Mixing with the high-temperature condensate (above 350 F) serves to further heat the makeup before it enters the boiler with the condensate.

These various operations are automatic because control is tied to changes in boiler-water level, which changes, in turn, either indicate a lag in condensate return or a need for makeup because of losses in the system.

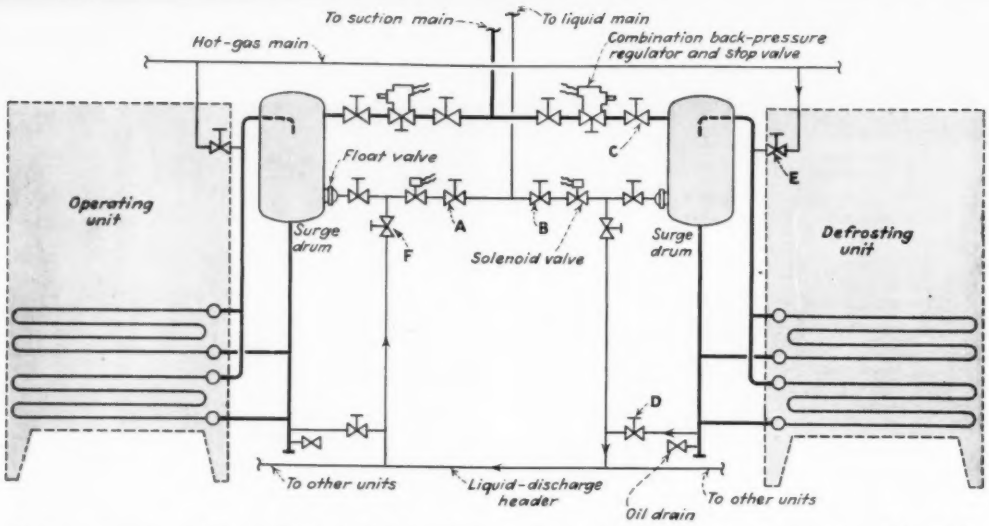
Operation of Controls. When storage-tank level drops, the makeup pump starts and the float in the makeup tank opens the valve to admit cold water to the system. At the same time a mercury switch on the float mechanism tilts to energize a timer and an auxiliary pulsator valve in the makeup line, which breaks up the makeup flow into a series of pulses. The timer operates on 15-second cycles and can be adjusted to supply water for any percentage of each interval, in accordance with average demand for makeup.

As the cold makeup water reaches the 2-stage direct heater it exerts a cooling action on a thermostatic element in the outlet. This, in turn, opens the main pulsator valve between the high-pressure condensate separator and the 2-stage heater. The return system is thus momentarily opened to low pressure as steam flows from the condensate separator to the 2-stage heater. The resulting heating of makeup reacts on the thermostatic control to again close the pulsator valve.

The action of the cold makeup water on the thermostatic element is superimposed on, and amplifies, a cyclic heating and cooling action, which operates the pulsator valve regardless of makeup-water flow. The thermostat is set at a temperature higher than that in the 2-stage heater on the discharge side of the pulsator valve but lower than that in the return line above the valve. As the thermostat cools, the pulsator valve opens. Release of condensate-steam mixture from the separator to the 2-stage heater acts to heat the thermostat and closes the valve. The cycle then repeats.

Modified Hookup. In the normal hookup, as we have seen, heated and deaerated makeup joins high-temperature condensate before entrance to the boiler. At The Jackson Box Co this arrangement is modified slightly as reference to the general diagram on page 115 shows. The returned condensate at high temperature (330 to 350 F) is pumped directly into the boiler. Makeup water from the condensation-return unit's tank goes to the plant boiler-feed pumps (two 6x4x6-in. Worthington duplex units) which discharge through the condensate separator and thence to another heat exchanger. Here the makeup picks up additional heat from the returns of the No. 1 corrugating machine, on their way to the condensation-return unit. From this heat exchanger makeup enters the boilers under control of Copes feedwater regulators. The boiler-feed pumps are controlled by Fisher governors.

At present, only the major steam users, the corrugating machines, are metered. A single Bailey flowmeter measures steam supplied to these units. It is planned that the hookup will be changed so total steam consumption can be measured. With fuel input determined by gaging tanks daily, it will then be possible to secure an operating check on boiler performance.



1 Solenoid-operated valves installed in the liquid and gas lines of each cooling unit for thermostatic control helped to simplify defrosting procedure because they eliminated the manual operation of regular stop valves by the man on watch

Cuts Cooler Defrosting Time From

Sometimes the operating procedure planned on paper does not work out in practice. Here is one instance where trial-and-error tests saved the day by speeding up a time-consuming job

By M N KRAUS,

Assistant to Supervising Engineer, City Plants, Sheffield Farms Company

► LARGE MOISTURE LOAD of products stored in a refrigerated space that was to be maintained at 35 F led us to believe we might have trouble with frosting-up the finned coils of a bank of unit coolers, arranged parallel to one wall. Using water sprays over the coils was not considered economical so hot-gas defrosting was installed, Fig. 1.

Design Procedure. Principle of this system was to use hot gas from the compressor discharge main to force liquid refrigerant from the coil to be defrosted into an operating coil. The latter unit would function normally, except that it would get its refrigerating liquid from the defrosting unit instead of the main liquid line.

Operating Procedure. Defrosting, Fig. 1, was to be done as follows:

1. Stop the blowers on the defrosting unit.
2. Close liquid valve *A* on the main supply to operating unit.
3. Close liquid valve *B* and suction valve *C* on defrosting unit.
4. Open the liquid drain valve *D* and hot-gas valve *E* on the defrosting unit.
5. Open liquid valve *F* on the operating unit.

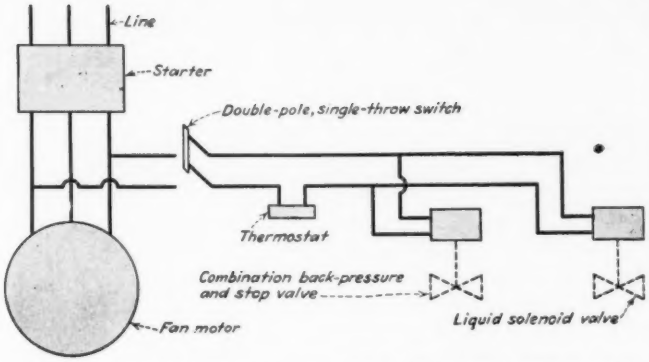
These instructions were complicated and somewhat difficult to follow because suction valve *C* was practically inaccessible to the operator. A little study revealed that by installing a double-pole single-throw (DPST) switch in the solenoid-valve control circuit, Fig. 2, it would not be necessary for the operator to close valves *B* and *C* manually. Opening the switch would close the solenoid valves and isolate the unit from the liquid and suction mains.

Initial Performance. After erection and testing, we studied the manner and extent of frost build-up so we could set up a defrosting schedule. The distance between bare fins was measured, and the space remaining after frost build-up was observed hourly. In eight hours, space between fins measured one sixteenth of an inch and we tried defrosting. We actually found it impossible to defrost a unit in four hours!

Starting up the units simultaneously had permitted all coils to frost up until their capacity was greatly reduced; consequently, it would take many hours to evaporate the refrigerant in the defrosting unit.

Time Reduced. On the next trial one unit was kept idle eight hours and the liquid from a defrosting unit then dumped into its frost-free coils. This rapid evaporation of the refrigerant cut the defrosting time to one hour. During this period the operator stayed in the cold room to watch results and guard against hot gas blowing into the operating unit. Such a situation could not be tolerated because it would keep the operator away from his hourly duties. In fact, defrosting would occupy all his time.

More Trouble. One reason advanced for the long defrosting time was that the hot-gas line from refrigerator to engine room had been left uninsulated. The long run (150 feet) cooled the gas to the point where it was ineffective for defrosting. Insulation of the line was recommended. It was also pointed out that instead of flowing during defrosting, the hot gas would remain dormant, merely displacing the defrosting-unit



2 Cooling unit is now defrosted by opening a double-pole single-throw switch installed in the feed circuit to thermostat and solenoid valves of each cooler

4 Hours to 30 Minutes

liquid as it flowed into an operating unit. Entire volume of gas in the line would have to be displaced before hot gas could reach the coils of the defrosting unit.

To prove this, the original operating instructions involving manual operation of the valves were followed, except suction valve *C* was left open to permit hot gas to flow directly into the suction main from the defrosting unit. It took over five minutes for hot gas to reach the defrosting unit, after which suction valve *C* was closed and defrosting accomplished in the normal manner. Defrosting time was the same despite the use of hotter gas.

Valve Restricted. Next reason advanced for the long defrosting period was that the operating unit might be running at part load. If so, its float valve would restrict flow of liquid from the defrosting unit. This, together with the fact that a definite volume of liquid must be displaced from the defrosting unit, would make the defrosting period different for different loading conditions. This assumption seemed logical so the values in the table were calculated to determine the shortest possible defrosting period.

These calculations show that if the operating unit ran at full load it would take 25.6 minutes to displace all liquid in the defrosting unit, and at half load 51.2 minutes. Additional time would be required for heat transfer to the fins and for the frost to slide off into the drain pan. The calculations also proved there was little prospect of reducing the defrosting time so another approach was necessary.

Speed at Last. At first, a suggestion to stop the blowers during defrosting appeared illogical because heat could be absorbed by that part of the coils still bare or lightly frosted. But this heat would tend to raise the pressure and temperature of the liquid trapped in the coil of the defrosting unit and speed defrosting. As a test we left the blowers running on the defrosting unit and opened the DPST switch in the solenoid-valve circuit, thus isolating the coils from the liquid and suction mains. Ammonia-gas pressure built up within the coils and in a few minutes after reaching a pressure corresponding to room temperature the coils started to defrost. They were clean in 30 minutes.

As a regular defrosting schedule the operator merely opens the DPST switch on one unit every eight hours, continues on his appointed rounds, and, on his way back to the engine room, closes the switch in order to restore the refrigeration to the defrosted unit.

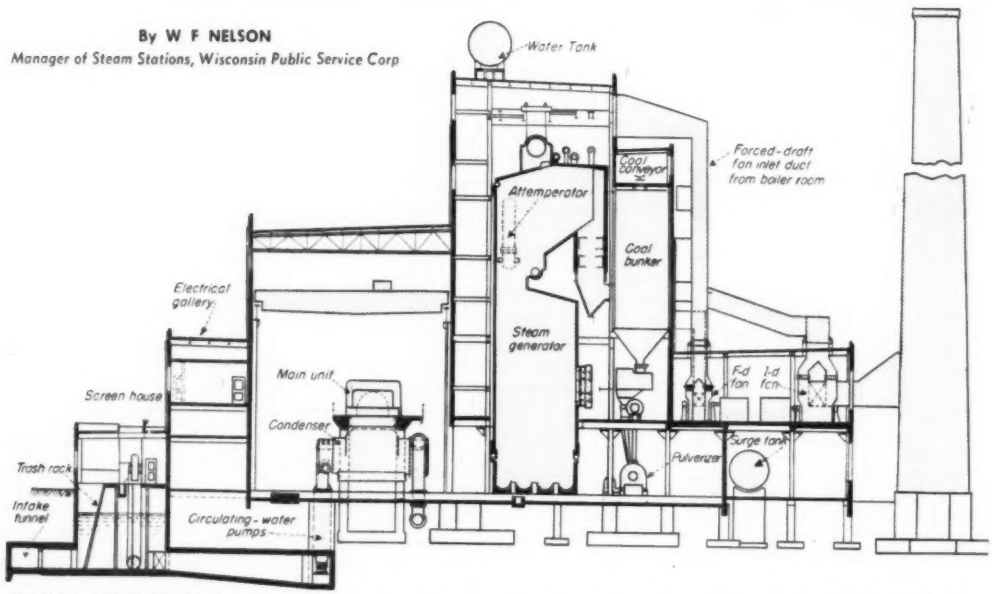
CALCULATIONS OF DEFROSTING CONDITIONS TO DETERMINE LENGTH OF TIME NEEDED

Heat in ammonia liquid under hot-gas pressure of 101 psig	113.7 Btu per lb
Heat in ammonia liquid in operating coil at 33.5 psig	64.7 Btu per lb
Heat lost by liquid in cooling itself to operating-coil temperature	113.7 − 64.7 = 49.0 Btu per lb
Latent heat of ammonia gas at 33.5 psig	617.8 Btu per lb
Heat available for cooling air passing over operating coils	617.8 − 49.0 = 568.8 Btu per lb
Refrigeration rating of cooling unit	20 tons or 4000 Btu per min
Ammonia evaporated at full rating of unit	$\frac{4000}{568.8} = 7.05$ lb
Volume occupied by one lb of liquid ammonia at 101 psig	0.02611 cu ft
Volume of liquid ammonia demanded by operating unit at full rating	7.05x0.02611 = 0.184 cu ft per min
Volume of liquid contained in coils, cu in.:	
Coil headers 602	
Connecting nipples 75	
Return bends 86	
Liquid legs 330	
Tubes 7100	
Total 8193 cu in.	
Time required to dump liquid from defrosting coils into operating coils	$\frac{8193}{1728 \times 0.184} = 25.6$ min

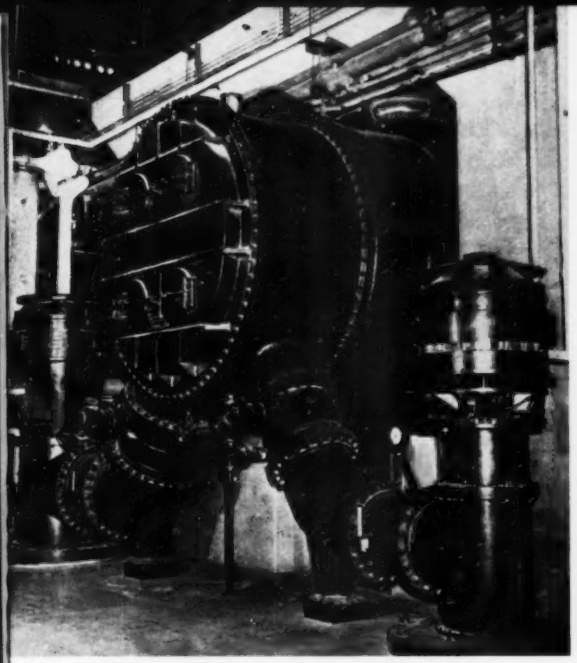
PLANT, OUTDOOR SUBSTATION and coal storage after completion of Unit No. 4. Discharge canal, center right, has recirculating canal at head end used to prevent formation of anchor ice at circulating-water inlet during cold weather

J P Pulliam Bayside Plant Expands

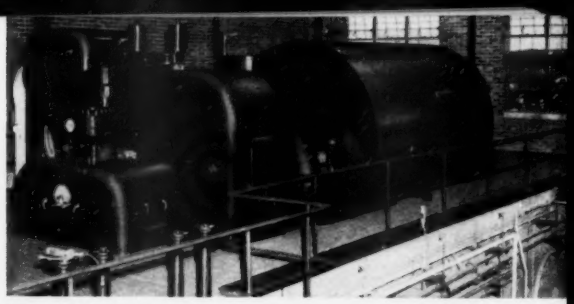
By W F NELSON
Manager of Steam Stations, Wisconsin Public Service Corp



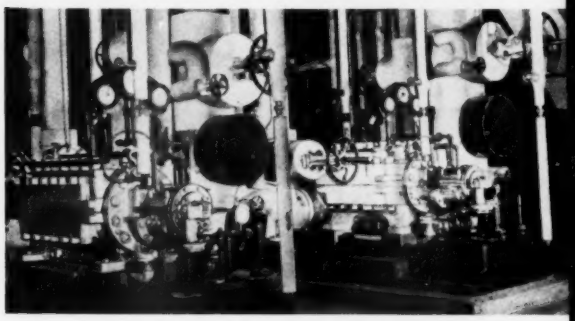
STATION ARRANGEMENT is characterized by keeping most auxiliaries at lower levels. Single boiler feeds main turbine through relatively short steam lead. Both forced-draft and induced-draft fans are housed in low-head bay on the right



SINGLE-PASS SURFACE CONDENSER has two circulating pumps; large one, left, has 60% of capacity, small one, 40%



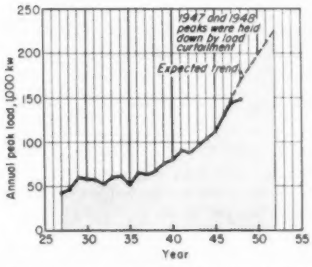
UNIT NO. 4 rated at 30,000 kw takes steam at 650 psig, 900 F, exhausts at 0.75 in. Hg abs; 4 bleed points heat feed



TWO OF THREE boiler feed pumps are motor driven, have 825-gpm capacity, turbine-driven pump handles 550 gpm

To Catch Up With Rocketing Demands

Station auxiliary capacities are selected for efficient operation in conjunction with system's hydro stations; new unit has capability exceeding 13% of its rated kw capacity



PEAK LOAD GROWTH has accelerated greatly since war, last peaks held down

► On August 8, 1947 the Wisconsin Public Service Corp placed in operation Unit No. 4 in its J P Pulliam Bayside plant, Green Bay, Wis. This unit adds 30,000 kw to the system, using three steam plants at Green Bay, Oshkosh and Manitowoc and 18 hydro plants on six rivers in Wisconsin and northern Michigan. The Pulliam Plant now has 80,000-kw installed capacity, about 50% of the system total.

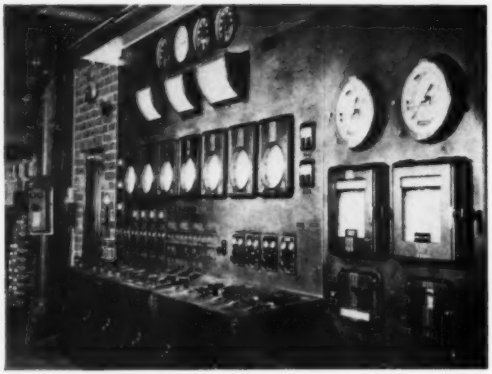
Unit No. 3, also 30,000 kw, went into service in Feb 1943. Further expansion was impossible during the war. No. 4 was started in the spring of 1945. Continued rapid growth, see graph lower left, required additional capacity. Accordingly, construction of Unit No. 5 was undertaken before No. 4 went into service. No. 5 will be a 50,000-kw 850-psig 900-F unit supplied by a 460,000-lb-per-hr steam generator. Two ball-mill pulverizers will serve the boiler furnace rated at 34,500 lb per hr each. Four bleed points will supply steam to one deaerating and three closed heaters for feedwater heating. Three boiler feed pumps each capable of handling 60% of full-load feedwater flow will be motor-driven.

No. 5 will go into service during the fall of 1949. Studies are now under way to provide additional capacity. System peak loads in 1948 and 1947 were held below potential levels by curtailing service because of lack of capacity and inability to purchase sufficient energy from interconnected systems.

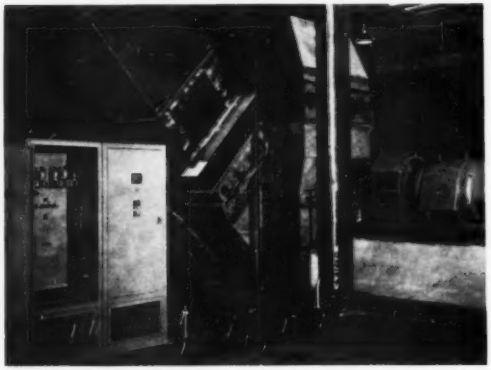
Unit No. 4. Experience with No. 3 pointed the way to changes made in No. 4 with the object of simplifying operation and improving reliability. Flexibility and ease of controlling low-load operation are important when operating a steam unit in parallel with hydro units. The radiant-type steam generator has a continuous-tube convection-type superheater, a submerged attemperator, a watercooled hopper-bottom furnace, economizer and regenerative air heater.

Full boiler rating of 312,500 lb per hr at 675 psig and 900 F can be produced when burning coal with 11,200 Btu per lb, 11.4% moisture (5% surface moisture) and 1900-F ash-softening temperature. Guaranteed full-load boiler efficiency equals 86.24%.

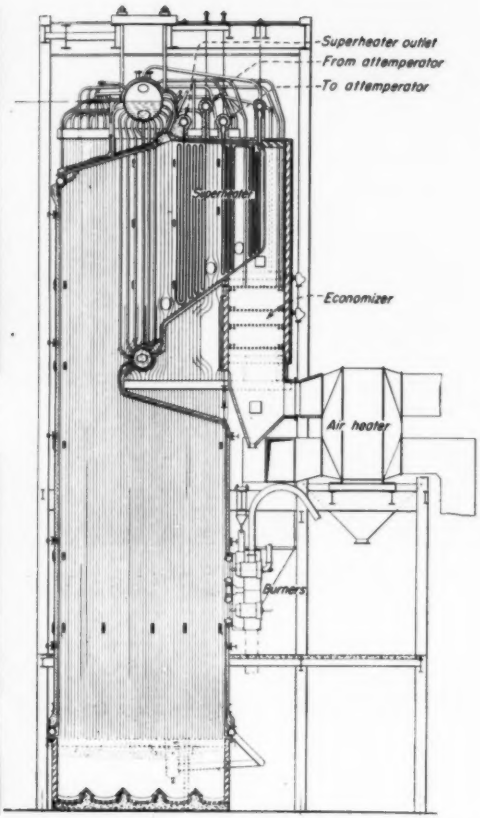
Existing coal-handling facilities were extended by lengthening the distributing conveyor to load two new 200-ton silo-type bins. From here, coal passes through automatic coal scales to two



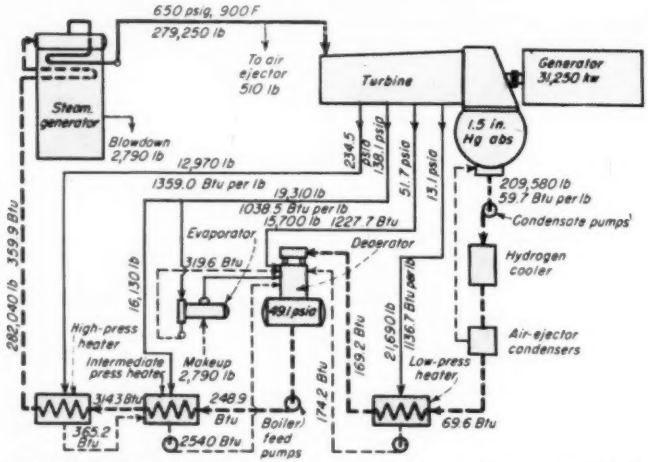
BOILER CONTROL BOARD centralizes supervision for single unit through automatic combustion-control system, instruments



ONE OF TWO forced-draft fans, which are motor driven through magnetic couplings with electronic controls, at left



RADIANT BOILER rated 312,500 lb per hr continuously has attemperator superheat control and regenerative air heater



HEAT-BALANCE CYCLE uses deaerating heater, operating at 49 psia at rated load; three closed heaters fed from 4 bleed points; i-p heater has integral drain cooler

table-type feeders, then to two ball-mill pulverizers with capacities of 10 tons per hr each. Two exhausters deliver the powdered coal to four intervane burners. Low-capacity nozzles in the burners handle low load conditions efficiently.

Two motor-driven forced-draft and two motor-driven induced-draft fans serve the boiler. The fans were chosen to carry 65% steam rating with one of each in service. The additional capacity was provided to take care of a possible later installation of flyash-removing equipment. Operation has shown, however, that nearly full load can be carried with one fan of each running. All fans are driven by constant-speed motors through magnetic couplings. Electronic control of the couplings eliminates the need for exciters and gives very close speed regulation and fast response.

Motors driving the i-d and f-d fans, exhausters, pulverizers and coal feeders

are electrically interlocked and must be started in the order listed. Failure of both i-d fans trips out all motors listed below them while failure of an exhauster trips out its pulverizer and feeder, but leaves the fans running. Failure of one i-d fan will not initiate the interlock. Since the fans are driven through magnetic couplings, interlocking action starts from these couplings and not from the motor drives.

The single-cylinder 30,000-kw turbine drives the hydrogen-cooled 80%-pf generator and its direct-connected main and pilot exciters at 3600 rpm. Four bleed points supply three closed heaters, one deaerating heater and an evaporator. Steam exhausts to a single-pass 15,900-sq-ft surface condenser. Two vertical circulating-water pumps serve the condenser. Pump capacities are proportioned 60 and 40%, the larger pump to be used alone during winter months. A triple-element steam-jet pump removes air from the condenser.

Two motor-driven 825-gpm boiler feed pumps can each deliver full feedwater requirements. A third turbine-driven 550-gpm boiler feed pump can carry 60% of rated unit load.

Chemicals used for water conditioning are sodium phosphates (mono, di, tri), sodium sulphate, sodium hydroxide and sodium sulphite. Instead of using a chemical feed pump, the dissolved chemicals are placed in a pressure tank and the boiler feed pressure on the inlet side of the economizer forces the dosage into the boiler drum. The following boiler-water conditions are maintained:

Dissolved solids	less than 200 ppm
Phosphates as PO_4	10 to 30 ppm
Sulphite as Na_2SO_3	20 to 30 ppm
Hydroxide as NaOH	20 to 50 ppm
Silica as SiO_2	less than 16 ppm
Embrittlement ratio	under 2.5
pH	10.9 to 11.1
Dissolved O_2	less than 0.03 ml/l
Suspended matter	minimum

Study of the aerial view and station cross section, page 120, will show that it was necessary to extend the intake tunnel for cooling water. Two additional traveling water screens were installed in a separate screen house. The existing chlorinating equipment has sufficient capacity to treat the additional cooling water for No. 4.

Electric System. The 2300-v auxiliaries are fed from a 2-section bus tied together through a circuit breaker. One section ties through a breaker to the reserve transformer bank and the other through a breaker to the station auxiliary transformer bank. Wherever possible the important auxiliaries have been split into two units with one of each connected to one of the two bus sections. With this arrangement, failure of one section of the bus will not cause a complete shutdown. A somewhat similar arrangement has been provided for the important 230-v auxiliaries.

Two additional breakers were added to the existing 66,000-v ring bus. No. 4 feeds directly to one section of this bus through a 36,000-kva bank of transformers. The unit is isolated from the ring bus by opening the two breakers at each end of the section, which also opens the ring. No connections are provided between No. 4 and other units on the 14,000-v side.

First-Year Record. During its first full year of operation Unit No. 4 has been available 96.8% of the time. But of the 3.2% outage time, or 279 hr and 35 min, only 4 hr and 35 min were forced outages resulting from a number of small repairs that were needed, none involving a large amount of time. During the longest planned outage, 250 hr, all the equipment was inspected, including auxiliaries, and various flanges tightened.

During the first year the unit generated 259,995,000 kwhr gross with a net output of 245,843,000 kwhr; 5.5% was needed for auxiliaries. The unit capacity factor for the period was 98.6% and the maximum load carried by the unit was 34,000 kw. This gives a unit load factor of 87.1%.

Over-all economy of the unit has fully met expectations. Based on kilowatthours to distribution, net heat rate for the first 12 months has averaged 12,555 Btu per kwhr, equivalent to a thermal efficiency of 27.2%. Contributing to this performance was the average boiler efficiency of 86.6%.

PRINCIPAL POWER-PLANT EQUIPMENT

J P Pulliam Bayside Plant, Unit No. 4, Green Bay, Wis. Wisconsin Public Service Corp

STEAM-GENERATING EQUIPMENT:

Boiler, 1 ..... Babcock & Wilcox Co
Radiant type, 312,500 lb per hr, 675 psig, 900 F, 2650 sq ft heating surface, 5642 sq ft waterwalls, 19,850 cu ft furnace volume, 20,380 Btu per hr per cu ft heat release, 4 coal burners
Economizer, 1, 6763 sq ft ..... Babcock & Wilcox Co
Superheater ..... Babcock & Wilcox Co
Two sections, 12,745 sq ft, attemperator control
Air heater, 1, regenerative ..... Air Preheater Corp
Soot blowers ..... Diamond Power Specialty Corp
Pulverizers, 2 ..... Foster Wheeler Corp
Ball-mill type, 20,000 lb per hr each, driven by 250-hp 900-rpm squirrel-cage motors, complete with exhausters and feeders
Forced-draft fans, 2 ..... Buffalo Forge Co
57,000 cfm each against 15 in. H_2O, driven by 200-hp 1200-rpm constant speed motor
Forced-draft fan speed control .... Electric Machinery Manufacturing Co
Magnetic coupling with electronic control
Induced-draft fans, 2 ..... Buffalo Forge Co
100,000 cfm each, 14 in. H_2O static press, driven by 350-hp 900-rpm constant-speed motor
Induced-draft fan speed control .. Electric Machinery Manufacturing Co
Magnetic coupling with electronic control
Combustion control ..... Bailey Meter Co
Coal scales ..... Richardson Scale Co
Ash-handling equipment ..... Allen-Sherman-Hoff Co
Stack, concrete, 1 ..... Consolidated Chimney Co

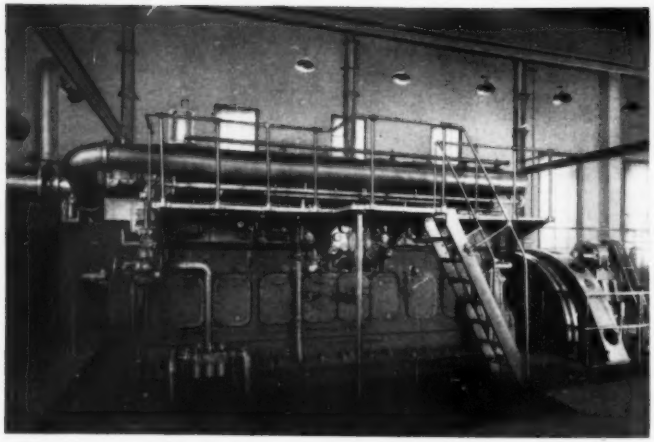
MAIN GENERATING UNIT:

Turbine-generator, 1 ..... Westinghouse Electric Corp
30,000 kw, 650-psig 900-F throttle steam, 0.75-in Hg abs exhaust, five bleed points, one blanked off, 3600 rpm, hydrogen-cooled 37,500-kva generator for 3-phase 60-cycle 14,000-v operation
Oil purifier ..... Bowser, Inc
Condenser, 1 ..... Allis-Chalmers Manufacturing Co
15,900-sq-ft surface, single pass
Condenser tubing, antimonial Admiralty ..... Chase Brass & Copper Co
Circulating pumps, 2 ..... Allis-Chalmers Manufacturing Co
1, 22,000 gpm, vertical driven by 200-hp 390-rpm 2300-v motor
1, 11,800 gpm, vertical driven by 100-hp 580-rpm 2300-v motor
Condensate pumps, 2 ..... Allis-Chalmers Manufacturing Co
500 gpm each driven by 60-hp 1750-rpm 220-v motors .....
Steam-jet air ejector 1 ..... Allis-Chalmers Manufacturing Co

AUXILIARIES AND MISCELLANEOUS:

Boiler feed pumps, 3 ..... Ingersoll-Rand Co
2, 825 gpm; 1, 550 gpm, 2250-ft head, 3600 rpm
Boiler feed pump drives, 2 ..... Westinghouse Electric Corp
700-hp 2300-v 3600-rpm motors
Boiler feed pump drive, 1 ..... Terry Steam Turbine Co
500-hp 3600-rpm steam turbine
Deaerating heater, 1 ..... Elliott Co
Operating pressure 49 psia, storage tank, vent condenser
Feedwater heaters, 3 ..... Alco Products Div, American Locomotive Co
1, low-press, closed heater, 12 psia press; 1, intermediate-press, closed heater with integral drain cooler, 131 psia operating press; 1, high-press closed heater, 223 psia
Piping contractor ..... M W Kellogg Co
Piping insulation ..... Smith-Totman Co

Consulting Engineers ..... Pioneer Service and Engineering Co



SUPERCHARGED GAS-DIESEL installed in the municipal plant at Cherokee, Okla. This is a 15½x22-in. 4-cycle engine fitted with an exhaust-gas-driven supercharger

Continued development of diesels capable of operating on fuel oil or gas makes possible highly profitable applications where gas fuels are available*

By **RALPH L BOYER**

Vice-president and chief engineer
The Cooper-Bessemer Corp

Dual-Fuel Engines Cut Costs

► OVER A PERIOD OF YEARS there have been a number of engine developments referred to as dual-fuel. The term is thus perhaps in need of some explanation. This paper deals with engines which burn gaseous fuels and fuel oil. These operate on the full diesel cycle, whether on gas or oil fuel, and are immediately convertible from one fuel to the other. While some attempt is made to report generally, the performance data given are strictly those with which the author is directly familiar.

In all cases we are dealing with engines in which the gas supply is in the cylinder during the compression stroke. In the 4-cycle nonsupercharged type, some builders admit the gas to the air stream, either in the common stream to all cylinders or in the air-intake valve passages. Some prefer to time gas admission so it only enters while the intake valve is open. We find that permitting continuous gas flow into the intake-valve passages gives excellent performance, and timing has not been necessary.

Supercharged Engine. The supercharged engine presents an entirely different problem. There it is necessary to overcome supercharging air pressure and, since scavenging is a major part of the supercharging cycle, it is also necessary to time the gas admission to prevent loss of fuel through the valve. Some builders prefer to admit gas directly into the cylinder, but our preference is for admission to the air stream only, whether the engine is supercharged or not.

Control for such an engine can be a simple matter. If, after starting on oil, the operator turns on the gas, the governor merely backs off because of the combination of fuels but continues to govern both. If he then moves the oil control to the "pilot" position, injecting only enough to maintain ignition, the engine operates as a gas-diesel.

Oil Operation. To return to oil operation, it is only necessary to release the oil control from the pilot position and turn off the gas. Even automatic changeover involves no complication. If the governor linkage is arranged so first half of travel controls gas supply while second half controls oil, the engine will switch automatically from one to the other, always burning all gas available. If gas supply fails, governor drops back into the oil range.

All builders of dual-fuel engines have a right to be proud of the results obtained. In our own case, we can definitely rate the engine at a higher bmep on gas than on oil. Detonation is practically unknown on 4-cycle engines and is not particularly serious on 2-cycle.

Gas Operation. Cylinder peak pressures are no higher with gas-diesel operation than with oil and, in fact, tend to be a little lower. The same is true of exhaust temperatures. There is a definite gain in smoothness of operation on gas and it is easy to tell by engine sound which fuel is being used. There have been practically no mechanical troubles with dual-fuel units over and above normal experience with oil diesels. The only field criticisms of importance were those applied to some of the original engines where fuel consumption at light loads was not at all good. This has been corrected until now the engine is quite efficient at all loads.

Since practically all dual-fuel engines produced by my company are 4-cycle, we deal mainly with that type here, although we have done much experimental work on the 2-cycle type and have produced such engines. In spite of several years work we have found it difficult to bring fuel consumption to less than 8000 Btu per bhphr at full load, based on about 62 bmep. When one considers other 2-cycle gas-engine types, this is good performance, yet it doesn't match accomplishments with the 4-cycle design.

The nonsupercharged 4-cycle engine has had largest development activity and greatest field experience. It is now being rivaled by the supercharged version, which gives a considerably better account of itself (see comparative performance data, p 125, top). It can be

*Abstracted from a paper, "Status of Dual-Fuel Engine Development," presented at the SAE annual meeting, Detroit, Mich., Jan 10-14, 1949.

seen that the original nonsupercharged dual-fuel engines considerably bettered spark-ignition gas engine performance at full load but light-load operation was disappointing. This was corrected and such an engine now consumes about 6800 Btu at full load and only 11,000 at quarter load.

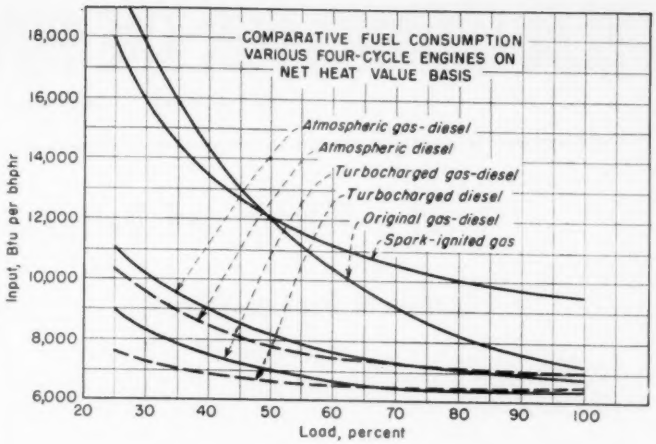
Note that this performance is better at full load than the same engine as an oil diesel and only 700 Btu's higher at quarter load. The supercharged engine shows phenomenal performance. It produces a bhphr for 6400 Btu and has a maximum at quarter load of 9000 Btu. Again it is better than the same engine as an oil diesel at full load, crosses the line at about three-quarter load, and is about 1400 Btu higher at quarter load.

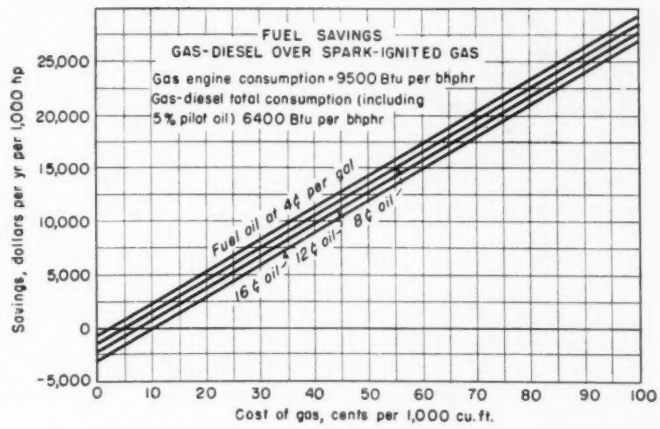
Natural Gas. Natural gas is America's ideal fuel. While the dual-fuel engine is not limited to natural gas, having successfully burned others, including refinery, manufactured, sewage and propane gases, a high percentage of the units operate on natural gas. Dual-fuel development proved timely as it was almost concurrent with a rapid rise in oil prices. With similar performance characteristics for gas-diesels and oil-diesels, a direct cost-per-Btu comparison of the fuels proves interesting. For example, we rarely find industrial gas costing more than 65¢ per 1000 cu ft and, since this compares directly with oil at 11¢ per gal, it is apparent that even in remote districts where natural gas is most expensive, it can compete with fuel oil. In the gas-producing districts, 20¢ gas is common, 10¢ gas not particularly unusual, and 6¢ gas is an actuality in a large Southwestern plant.

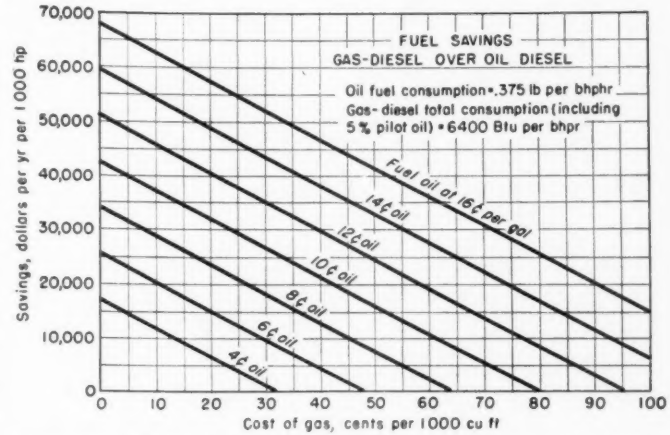
It is fully appreciated that most installations experience a variable load factor. With modern developments the gas-diesel performs so much like the diesel that a full-load comparison is not particularly misleading. Using full load as the comparison point favors the gas-diesel, but only slightly. On the other hand, using full load as the comparison point between gas-diesels and straight gas engines favors the gas engine, since the gas-diesel gives far better performance at light loads.

Comparison Curves. To permit a reasonably accurate picture by which a decision can be made as to whether a dual-fuel engine can compete, the comparison curves at the right are presented. These show savings in dollars per year per 1000 hp for various fuel prices for dual-fuel engines in comparison with spark-ignition gas engines and oil diesels. It can be seen that these savings can be very substantial: $25,000 per year per 1000 hp for gas at 65¢ and

(*Continued on page* 168)







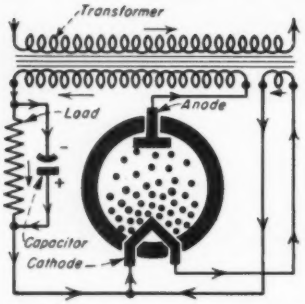
COMPARISON CHARTS show: fuel-consumption curves for various 4-cycle engines, top; fuel costs for gas-diesel vs gas engine, center; gas-diesel vs oil, bottom

ELECTRONICS FOR THE POWER ENGINEER

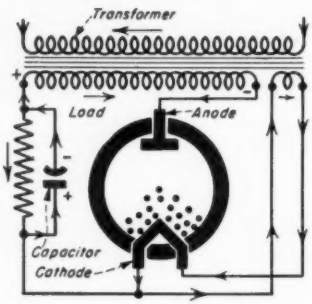
By F A ANNETT, *Associate Editor*

11—Filters and Voltage Doublers

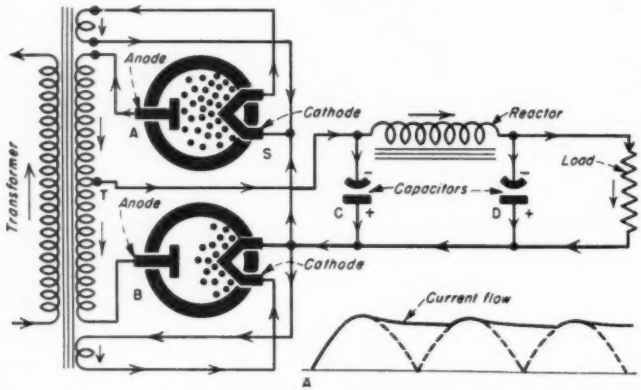
Capacitors Used as Filters



1 Capacitor connected across load to smooth out current flow in circuit

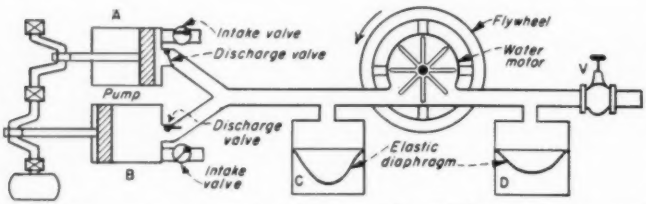


2 If a capacitor is connected across load, inverse voltage may be doubled



3 A full-wave rectifier connected to load through capacitor-reactor filter

4 Solid curve shows filter smooths pulsating flow from full-wave rectifier



5 Hydraulic analogy of rectifier, filter, Fig. 3. Crank-driven pistons equal rectifying tubes. Water motor and elastic diaphragms equal reactor, capacitors

► SEVERAL FORMS of filters are used to smooth out the dc output of electron-tube rectifiers. The type you select depends on the circuit and other needs. The simplest filter is a capacitor connected across the output circuit or a reactor connected in series with the load. When either of these does not give desired results, various combinations of capacitors and reactors are used.

Capacitors as Filters. Action of a single capacitor connected across the load, Fig. 1, was explained last month (POWER, Feb, p 126). It has the advantage of being simple. If a single capacitor is comparatively large and load resistance relatively high, it can be used as a filter for many small loads supplied through vacuum tubes.

When used with a gas-filled tube, peak currents may be high. This is because the capacitor, when being charged, acts as a short circuit across the tube. Under these conditions current flow may be high enough to damage the tube. For this reason, this type filter is objectionable for comparatively large currents.

When a capacitor is connected across the load, as in Fig. 1, the inverse voltage, with the load connected, is about twice the average dc voltage. When the load is disconnected the inverse voltage may be nearly double the transformer's secondary peak. A study of Fig. 1 and 2 shows why.

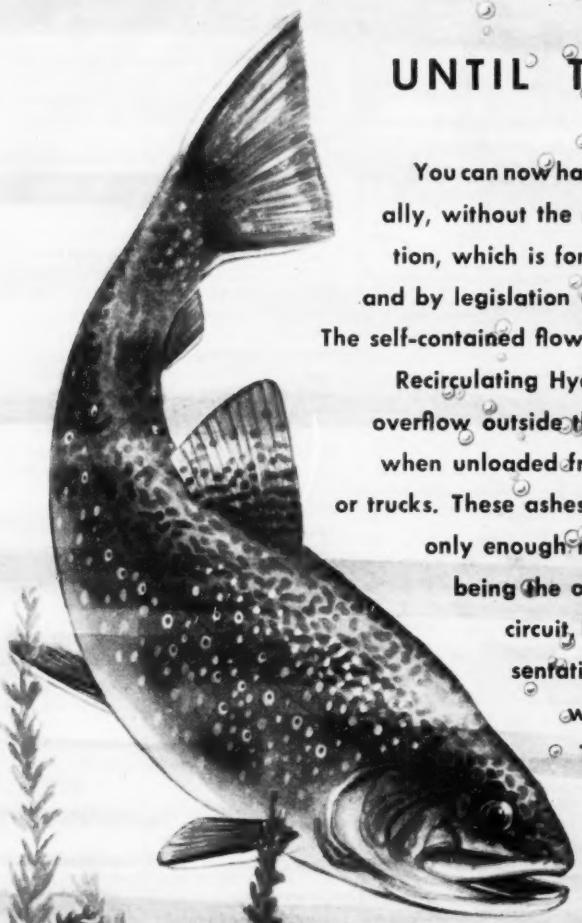
In Fig. 1, transformer polarity is such that the tube conducts. Current flows through the load and charges the capacitor of the polarity shown. After the ac voltage passes its peak the capacitor starts to discharge through the load.

If load resistance is high the capacitor loses its charge slowly. Consequently, when the transformer's polarity reverses, as in Fig. 2, the capacitor is charged to a large part of the transformer's peak voltage. The capacitor is now in series with the transformer of a polarity so their voltages add and tend to cause current to flow from anode to cathode through the tube, as indicated.

If the load were disconnected the capacitor would be charged to peak ac

Let the Fish Live

UNTIL THEY'RE CAUGHT

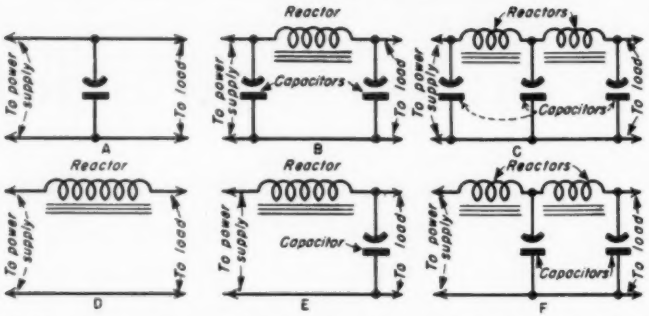


You can now handle any daily ash tonnage, hydraulically, without the slightest hazard of stream pollution, which is forbidden by the laws of many states and by legislation under consideration in others. The self-contained flow of water and ashes in the Recirculating Hydrojet System has no discharge or overflow outside the system, aside from the ashes, when unloaded from the Hydro Bin into railroad cars or trucks. These ashes are commercially dry and contain only enough moisture to prevent dust escape. This, being the only moisture to leave the enclosed circuit, becomes the only make-up. Our representatives have new Engineering Drawings which illustrate this Hydrojet Hook-up. They will gladly call on you anytime to explain how the system can be applied to new or existing installations.

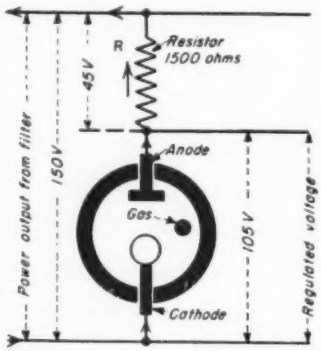
NON-POLLUTING *Hydrojet*

ALLEN-SHERMAN-HOFF CO., 227 S. 15th ST., PHILADELPHIA 2, PA. *Offices & Representatives in Principal Cities*

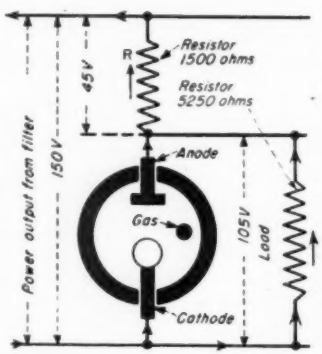
Filters and Voltage Regulators



6 Filters: A, 1 capacitor; B, 2 capacitors and reactor; C, 3 capacitors and 2 reactors; D, 1 reactor; E, reactor and capacitor; F, 2 reactors and 2 capacitors



7 Cold-cathode tube in series with a resistor holds the voltage constant



8 Resistance of a cold-cathode tube increases with decreasing current

voltage and, with the transformer, would submit the tube to an inverse voltage equal to double peak value. When voltages are comparatively low, doubling the inverse voltage across the tube is not serious. For higher voltages, however, doubling the inverse voltage may require special tube insulation.

When a single capacitor or reactor filter does not give smooth enough dc, a combination of capacitors and reactors is generally used, as in Fig. 3. This filter has two capacitors connected across the line with a reactor in series between them. Because the capacitors and reactor form a combination like the Greek letter π (pi) it is called a pi filter.

When the transformer has the polarity shown, voltage direction is from center tap *T*, the reactor, the load, tube *A* and to transformer. Current flow through the reactor's winding induces a counter voltage while the current is increasing.

This counter voltage opposes the rectifier voltage so the potential across the load is the difference between the two. That is, if rectifier voltage is 100 and counter voltage 25, then 100 — 25 = 75 appears across the load.

With this arrangement, capacitor *C* connected across the rectifier is charged to maximum rectifier voltage, and capacitor *D* connected across the load is charged to the potential across it, which is the difference between that of the rectifier and across the reactor.

When the rectifier's voltage passes its peak, capacitor *C* begins to discharge to maintain current flow in the circuit. Any decrease in current flow induces a voltage in the reactor to keep the current flowing. This voltage adds to that of the capacitor to help maintain constant current through the load. Capacitor *D* starts to discharge at any slight voltage drop across the load.

As a result of these actions, load current remains practically smooth if the capacitors and reactor are selected in proper relation to each other and to the load, as indicated in Fig. 4. Capacitor *C*, Fig. 3, is connected across the rectifier as in Fig. 1. This capacitor, however, can be smaller for a comparable circuit than when a single capacitor is used, Fig. 1. Peak current through the tubes, Fig. 3, is, therefore, proportionally reduced.

Fig. 5 shows a hydraulic analogy of the rectifier and filter circuit, Fig. 3. The crank-driven pistons in cylinders *A* and *B* correspond to the rectifying tubes *A* and *B*, Fig. 3. Cylinders *C* and *D* with their elastic diaphragms serve the same purpose as capacitors *C* and *D*, and the water motor with its flywheel corresponds to the reactor. Valve *V* is partly closed to offer resistance to fluid flow from the pump.

The piston in cylinder *B* has started discharging, and *A* is on suction. As the crank rotates, piston *B* increases in velocity until near the center of the stroke. Consequently, fluid velocity and pressure increase during this period. As pressure increases flow through the water motor and valve increases.

Because of its flywheel, the water motor resists being accelerated, and pressure builds up at its entrance to expand diaphragm *C*, as indicated, and stores water in its cylinder. Beyond the water motor the valve retards the flow just as the load resistance retarded current flow in Fig. 3.

Pressure acting on valve *V* is the difference between that developed by piston *B* and the backpressure offered by the motor. Diaphragm *D* will then be deflected less than *C* and store less fluid. This is just the condition that we have at the peak of the current wave, Fig. 3.

After piston *B* has passed its midpoint and begun to slow down, if it were not for the water motor and the expanded diaphragms, flow would also begin to decrease. When this happens diaphragm in *C* starts pushing water from its cylinder to help maintain system pressure and flow, just as capacitor *C* tended to maintain voltage on the system and current flow.

Any decrease in flow through the fluid motor tends to slow it down. The flywheel then begins to give up its energy to drive the motor as a pump to maintain pressure on the valve and constant flow through it. When the pressure begins to drop at the valve, cylinder *D* gives up some of the energy stored in its diaphragm to keep fluid flow nearly constant.

With a proper combination of cylinders *C* and *D* and flywheel weight on the water motor, the pulsating flow from the pump can be converted into a nearly constant flow through the valve. In fact, the fluid-flow curve would be comparable to the current-flow curve, Fig. 4.

Fig. 5 is a good example of how

(*Continued on page* 158)

Tops FOR TOP PRESSURES

On steam lines where pressures go as high as 1500 psi, and temperatures up to 900° F. are encountered, steam traps must be rugged . . . and *efficient!*

That's why so many public utilities and other high pressure steam plants are installing Yarway Integral Strainer Impulse Steam Traps. First cousin to the famous standard Yarway Impulse Steam Trap, the integral strainer trap has been developed especially to meet high pressure trapping requirements.

It has ample condensate capacity when system is being "warmed up." Yet it will handle relatively small amounts of condensate efficiently without losing prime. The valve closes positively in the presence of dry or superheated steam.

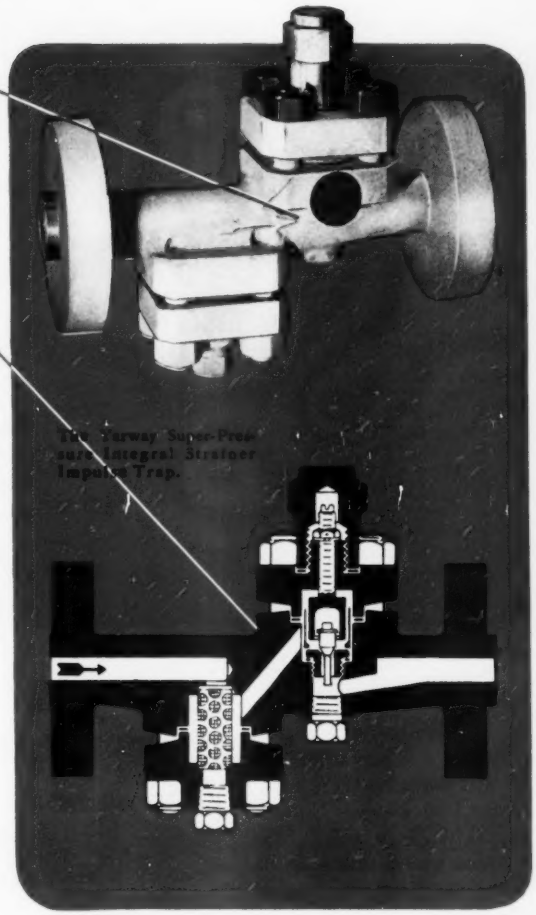
It is a fraction of the size and weight of other type traps designed for the same service—saving space, simplifying installation and requiring no supports.

It is suitable for all pressures within a wide range without change of valve or seat.

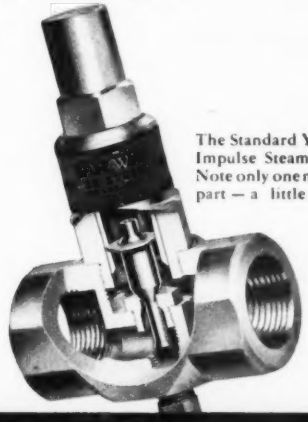
It has the same simplicity of design as does the standard Impulse Trap shown below—only one moving part, the same little valve.

Its integral strainer protects trap against scale and rust in the piping system.

Available with flanged or socket weld connections. Write for Bulletin T-1739.



The Yarway Super-Pressure Integral Strainer Impulse Trap.



The Standard Yarway Impulse Steam Trap. Note only one moving part — a little valve.

See these traps and other Yarway steam plant equipment . . . hear their operation described by Lowell Thomas in the Yarway color motion picture, "There Is An Engineering Reason." Available without charge for group showings. Write today.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.

YARWAY IMPULSE STEAM TRAP

POWER ENGINEERS' NOTEBOOK

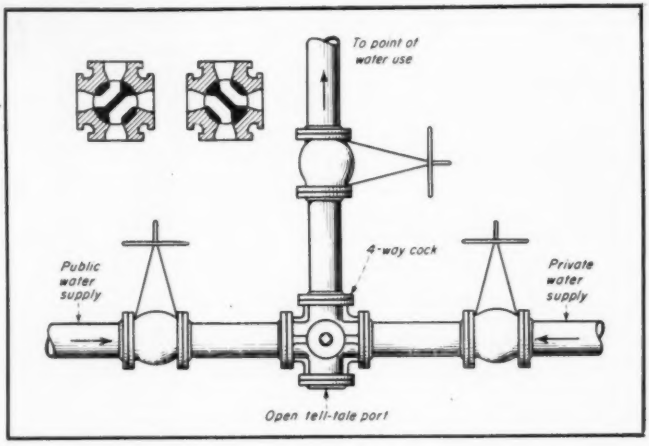
PLANT-TESTED IDEAS TO SOLVE PROBLEMS OF DESIGN, OPERATION AND MAINTENANCE

FOUR-WAY COCK MEETS HEALTH REGULATIONS

MANY GENERATING STATIONS and industrial power plants use considerable quantities of water from streams or wells that is unsuitable for drinking. Because of the hazard of pumping-equipment breakdown, an emergency connection to the local municipal system is often provided.

Frequently the State Health Department will not allow any direct cross-connections, using double check valves and the like. They approve removable spools, swing pieces and similar arrangements, but they take entirely too long to hook up, particularly in the large sizes. In emergencies it's likely the manpower may not be available either for such a job.

Sketch, right, shows an approved method of connecting two water supplies. A 4-way cock cross connects the two water-supply sources and the line to point of water use. By closing the valve from one water source, rotating the cock 90 degrees and opening the other water-source valve the supply may be changed from one to the other in a few minutes. If the 4-way cock rotates before the water is shut off from the source no longer used, the water will discharge from the telltale port. The cock cross section shows there is no way that water from one system can be discharged into the other.



In one installation plug cocks were used instead of gate valves on both supply systems. All three cocks were equipped with bell cranks attached to an air cylinder. When water pressure drops, compressed air enters the cylinder, automatically changing the water-supply source. The $400 cost can seldom be justified for automatic transfer where adequate labor is available or quick action is not needed.

E H ROPER *Toledo, Ohio*

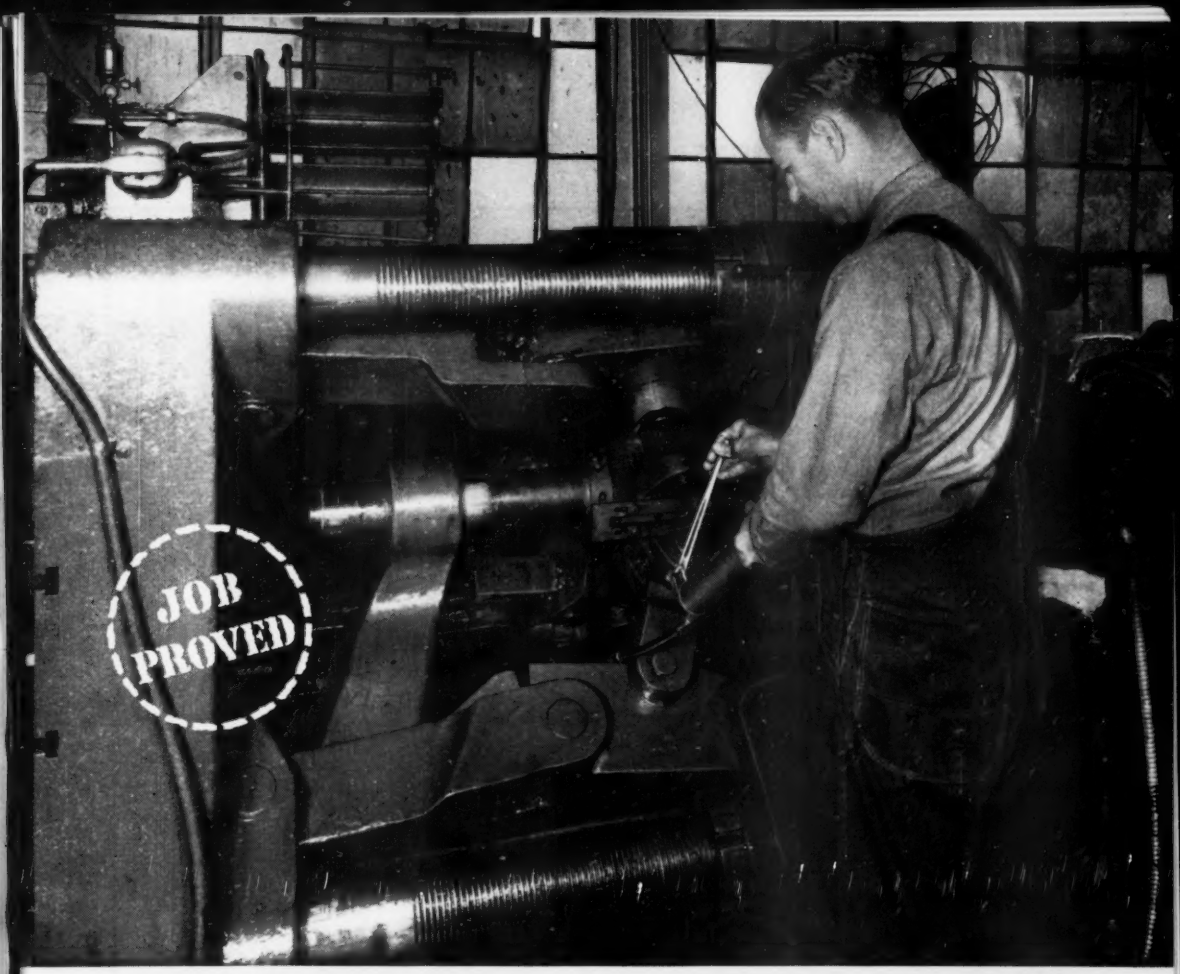
DRILL MOTOR THREADS PIPE THROUGH CAR TRANSMISSIONS

INSTALLATION of a 1000-hp engine in our plant called for much threading of different pipe sizes. To reduce time and labor we mounted our $\frac{3}{4}$-in. drill motor to drive the threader through two old car transmissions. The universal joint next to the threader, see photo, locks to the threader pinion shaft with a set-screw, where the ratchet handle ordinarily goes.

As the pinion shaft describes a large circle it was necessary to use the short shaft and universal joints. A lever, not shown, slides motor and transmissions back to disconnect. Spline shaft slipping out of universal joint permits quick dismantling. We turn out a 4-in. thread every 8 minutes.

H A BOST *Robstown, Texas*

(*Continued on page* 132)



$300 SAVED IN "PIN" MONEY

Sun Lubricant Reduces Toggle Pin Wear 70% and Minimizes Shutdowns in Die-Casting Plant

In injection-molding zinc die castings, a manufacturer was experiencing excessive wear and breakage in toggle pins. The lubricant in use, which was applied to the pins by gun, just couldn't stand up under heavy-duty operation.

Asked for his advice, a Sun engineer recommended a grease which had been "Job Proved" in many machines of the same type. Over a period of 14 months, use of this Sun grease resulted in 70 percent reduction in breakage of pins. Translated into hard cash, this represented a $300 saving. In addition, costly shutdowns for pin replacement were greatly reduced.

Records like this are not unusual in plants where Sun "Job Proved" greases and oils are used. You can rely on these lubricants to help keep equipment operating steadily and safely, with minimum time-out for maintenance. For the booklet "What Makes a Good Grease," write Dept. P-3.

SUN OIL COMPANY • *Philadelphia 3, Pa.*
In Canada: Sun Oil Company, Ltd.
Toronto and Montreal

SUN PETROLEUM PRODUCTS SUNOCO

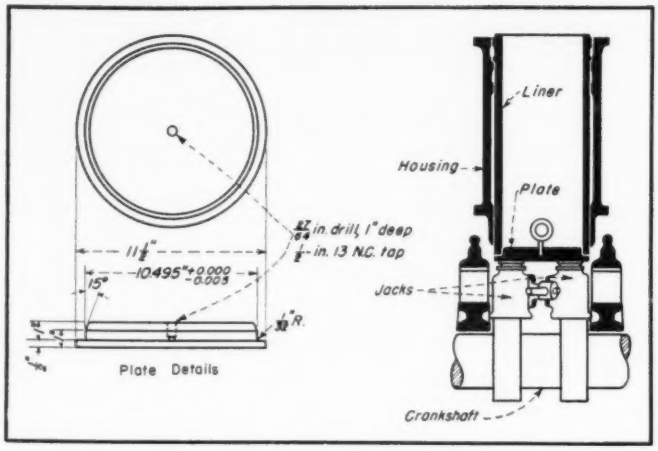
"JOB PROVED" IN INDUSTRY

HOW TO REMOVE WORN DIESEL-ENGINE CYLINDER LINERS

DURING THE FIRST general overhaul of our 450-hp 6-cylinder diesel engine we found two worn cylinder liners. We tried to remove the liners by placing a flat bar across the bottom end of the liner and pulling upward on it with the crane. The liners could not be budged by this method so we were forced to devise a more effective procedure.

We had our machine shop make a round steel plate to the specifications shown in the sketch. This plate was placed at the bottom of the liner as shown. The crank throw was rotated to a horizontal position and two jacks placed between the steel plate and the crankshaft. With the latter as support we worked the jacks till the steel plate bearing on the liners advanced upwards for a few inches. The crane could then lift out the liner.

JOHN R BROWN *Bauta, Cuba*



PUMP PRESSURE GOVERNOR SERVES TWO PURPOSES

It sometimes happens that one piece of power-plant apparatus can be made to do double duty and thereby save making an additional investment in another unit of equipment designed for one specific purpose.

Some time ago we purchased an excess-pressure governor for use on a reciprocating boiler-feed pump which supplemented a turbine-driven pump during heavy-load periods. During the extended light-load periods the reciprocating pump would be idle, leaving it free to do other work.

A motor-driven centrifugal pump served a tank that supplied the mill service water. The reciprocating pump is so piped that it can be used as a spare tank pump in emergencies as well as a peak-load boiler feed pump. But before installing the new governor the reciprocating pump had to be started manually if anything went wrong with the motor-driven tank pump.

Study of the operating principles of the new governor showed that if the control piping were properly connected the governor could be made to start the reciprocating pump automatically upon failure of the motor-driven pump.

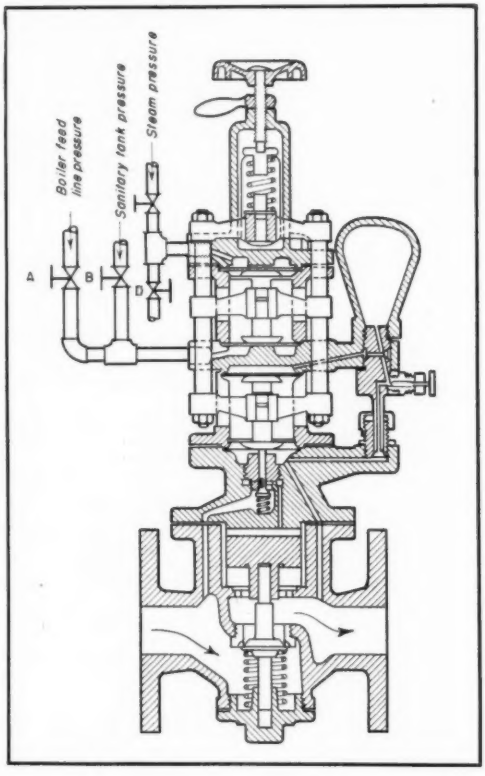
The cross section at right shows the arrangement of the principal working parts of the governor. Four diaphragms are balanced against each other and an adjusting spring at top through a yoke arrangement. Movement of the yoke controls the position of the governor valve in the steam line.

When used as an excess-pressure governor for boiler feed service, valve *C* from the steam line and water-pressure valve *A* are open and valves *B* and *D* are closed.

Excess boiler feed pressure is obtained by increasing the tension on the top spring, which unbalances the steam and water diaphragms. Any excess of feed over steam pressure within the range of the spring can be obtained.

When used as a tank-pump governor, valves *A* and *C* are closed, *B* and *D* are opened. This cuts out control of the steam diaphragm at the top, giving a simple tank-pump governor. Adjustment of the spring tension at the top of the governor then regulates the pump discharge pressure.

C BROOKS HUDSON *Plymouth, Mass.*



Take a *good* look at a *Liability*

Any boiler plant becomes a liability when improper water conditioning eats up profits by causing excessive blowdown, carryover . . . scale. But this liability can be turned into an asset with *correct* water conditioning . . . a matter of careful and scientific control.

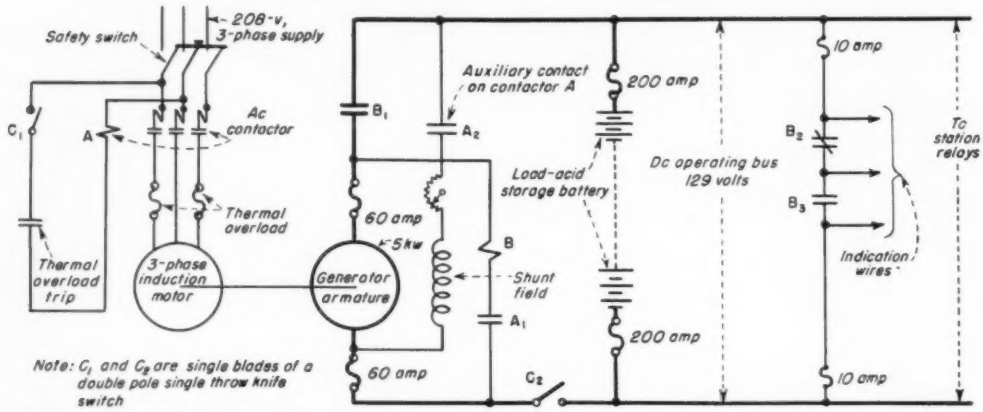
W. H. & L. D. BETZ is an organization of engineers and chemists specializing in the solution of all industrial water problems. Years of experience have made Betz water conditioning service scientifically correct . . . complete . . . economical. Our staff of engineers will welcome the opportunity of discussing your boiler water problems . . .
W. H. & L. D. BETZ, Gillingham and Worth Sts., Philadelphia 24, Pa.
In Canada: Betz Laboratories Limited, Montreal 1.

BETZ

BOILER WATER CONDITIONING • COOLING WATER CONDITIONING • INDUSTRIAL WASTE TREATMENT

PROBLEMS FROM THE PLANT

Exercise your engineering wits by submitting answers to this question, fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay



COMMUTATOR, BRUSH OR CONTACT trouble in generator armature circuit will interrupt current flowing to battery, allowing dc operating bus voltage to drop. We need prompt indication sent to distant control board when generator current fails

CAN SOLENOID RELAYS BE USED FOR REMOTE MG SET INDICATION?

We have several battery rooms containing control batteries and charging mg sets. They are located a long distance from main control point. Except for a short visit by an inspector once every 24 hours, battery and mg set are unattended. A set of indication wires run from auxiliary contacts on generator contactor, *B*, to our control board lights, giving us indication if generator is running.

It's important that the dc operating bus be kept at about 129 v. Should it drop below 115 v we will run into trouble because of critical nature of connected relay control circuits. On past occasions we have had a failure of generator charging current because of a poor contact, B_1, brush trouble or commutator fault.

In normal operation, mg set is started by closing safety switch and knife switch C_{1-2}. Ac contactor *A* picks up starting induction motor. At same time, auxiliary contacts A_1 and A_2 close since they connect to contactor *A*. Contact A_2 applies full shunt field from battery while contact A_1 puts coil of contactor *B* across generator armature. Coil of *B* is calibrated to pick up when generator open-circuit voltage is about equal to that of dc bus. Contact B_1 then closes, putting the generator in parallel with the dc bus. With closing of contactor *B*, its auxiliary contacts B_{2-3} send indication to control board.

What we are trying to have is a relay that will send indication back to our main control point as soon as generator current stops flowing. A low-voltage relay is not the answer since by the time voltage dropped to relay's operating point, elapsed time would make a serious cut into time left to get a man there and correct the trouble.

Can any Power readers give us a practical solution to the problem? We know there are reverse current relays on the market but since we have many solenoid-type relays on hand (PQ type) perhaps we could rewind them to include a potential and current coil.—*TC*

READERS' ANSWERS

How Can We Check Secondaries?

(This question is from December issue with best answers from readers.)

Although we periodically check the overcurrent relays on all our plant feeders, we never gave serious thought to the relay current transformers. After the relays failed to operate on a recent cable fault, we made a quick check and found them OK, but two of the current-transformer secondaries were shorted.

We fully realized, even though we made a thorough check on all relays, it meant nothing if the ct was shorted.

That started a systematic check on all current transformers. Using a series test lamp from a 120-v source, we spotted six ct with shorted secondary windings. The test consisted simply of noting the brightness of the test lamp in series with the transformer secondary. A dim light showed the winding OK while a bright light indicated a shorted secondary. [See sketch, p 138, Dec 1948, Power.]

We know this is but a rough check since it doesn't tell when only a few turns are shorted. The correct turn ratio is mighty important since it will determine the tripping point of the con-

Short Cut *to better drives!*

• Here's the easy way to select the right roller chain drive for your plant. This new stock drive catalog shows you in six easy steps exactly how to choose the chain and sprockets that will deliver the most for your money. Just follow the simple instructions and order the required chain and sprockets from your Baldwin-Rex Distributor. It's as easy as that.

You save time and money too! For the chains and sprockets listed in the catalog are stock items that will meet practically every type of working condition. By standardizing on these standard units, you will save on original costs . . . on replacement . . . reduce the amount and cost of material you must carry in stock.

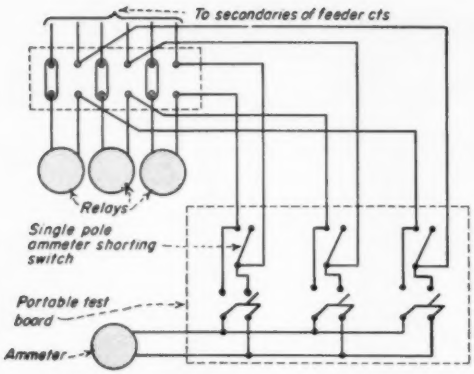
There's important information on lubrication, installation and maintenance of drives . . . specification and price data. In addition there's selection and other important data on flexible couplings.

Send for your free copy of Bulletin No. 48-1 today. See your Baldwin-Rex Distributor or write Baldwin-Duckworth Division of Chain Belt Company, 387 Plainfield Street, Springfield 2, Mass.

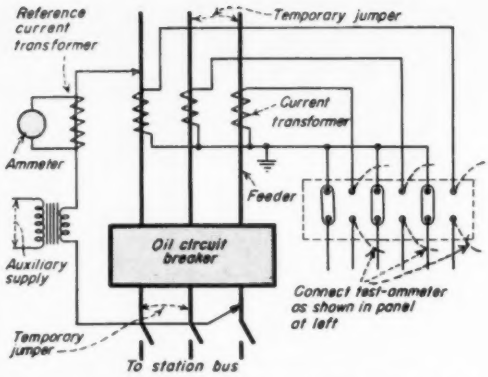
A complete line from ¼-inch to 2½-inch pitch

BALDWIN·REX
ROLLER CHAINS

BALDWIN-DUCKWORTH DIVISION OF CHAIN BELT COMPANY



MAKE PORTABLE TESTBOARD with 3 sets of sp and dp switches. One ammeter can then be used to read current in any relay



WITH MAIN CIRCUIT DEAD jump feeder as shown and have current from step-down transformer feed through all ct in series

nected relays. We would appreciate hearing how POWER *readers check ct in their plants. We have been thinking of making a simple impedance test. Would ammeter and voltmeter readings using a low voltage ac source do the trick?*—CA

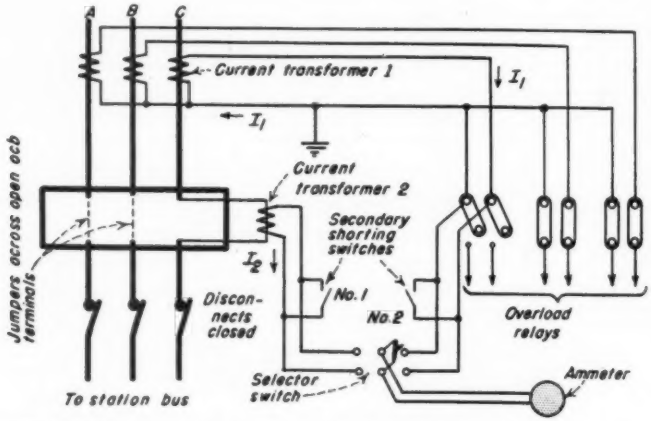
Several Tests Outlined

ASSUMING TEST is desired with circuit in live operation, simplest approach is to substitute an ammeter in place of one or all relays in conjunction with a split-core ammeter. Current flowing in both primary and secondary circuits can be determined with sufficient accuracy to spot shorted secondary windings.

Above sketches show how the test and reference ammeter are connected in the circuit. Use a short-circuiting switch in parallel with test links.

Test board can be made up as shown in left sketch. Here we have three single pole and three 2-pole single-throw switches. Switches are connected so current in any line can be read with one ammeter. Single-pole switches are normally closed. To read current in any line close 2-pole meter switch and open corresponding single-pole switch, placing ammeter in series with relay. This is standard test arrangement.

Sketch to right shows test setup where circuit is "dead." Current is supplied from an auxiliary source. Since all ct primaries are in series, same current flows in each. Individual ammeter readings indicate individual differences due to faults. Reference ct is shown although not absolutely necessary.



ONE AMMETER can check current through transformer No. 2 and all relay ct by using double-throw selector switch. Keep shorting switches closed if not reading meter

For greater sensitivity use indicating wattmeters instead of ammeters in secondary circuit. Being separately excited and having a scale more closely divided gives a better indication. Use a reference transformer of the same ratio in series with the ct under test. Connect secondaries of each ct to separate wattmeter. Use common potential source for wattmeters.

C O VON DANNENBERG

Brooklyn, N. Y.

Use Reference Transformer

WHEN *CA*'s current transformers are OK they will deliver a current to relay circuit which is a specified fraction of primary-line current depending on transformer turn ratio. Most satisfactory turn ratio test is to check if transformer secondaries are delivering desired current. If this current is low, it indicates ct secondaries are shorted.

Secondary currents can be measured using circuit shown in sketch to left. Use jumpers across the open breaker for two phases, and a ct across third phase. Secondary of this transformer, and of regular ct are brought out to selector switch and ammeter. Use following test procedure.

1. Close secondary shorting switches. These switches must be closed at all times when ammeter is not reading. A ct with an open secondary may build up a voltage 20 times normal, enough to endanger life and transformer.

2. Place *light* load in primary line and close disconnects.

3. Close selector switch to read I_1 and open shorting switch for transformer No. 1. Read current I_2.

4. Close shorting switch No. 1, reverse selector switch, then open short-

(*Continued on page* 174)

Your answer to Tube Dezincification–

ANACONDA ARSENICAL ADMIRALTY 439

ANACONDA began commercial production of Arsenical Admiralty Condenser Tubes in 1934—after two years of intensive research work. Tests had proved that a small percentage (0.04) of arsenic added to Admiralty Alloy materially increased its resistance to dezincification.

Since 1934, this improved alloy has performed outstandingly in almost every kind of service. Arsenical Admiralty Alloy 439 offers high heat transference as well as high resistance to general corrosion. It costs the same as plain Admiralty.

There are 8 standard and several special Anaconda Alloys for condenser and heat exchanger tubes. You are invited to consult our Technical Department in determining the most suitable alloy for your use. For general information on Anaconda Tubes and Tube Sheets, send for our Publication B-2.

ANACONDA
from mine to consumer

Anaconda

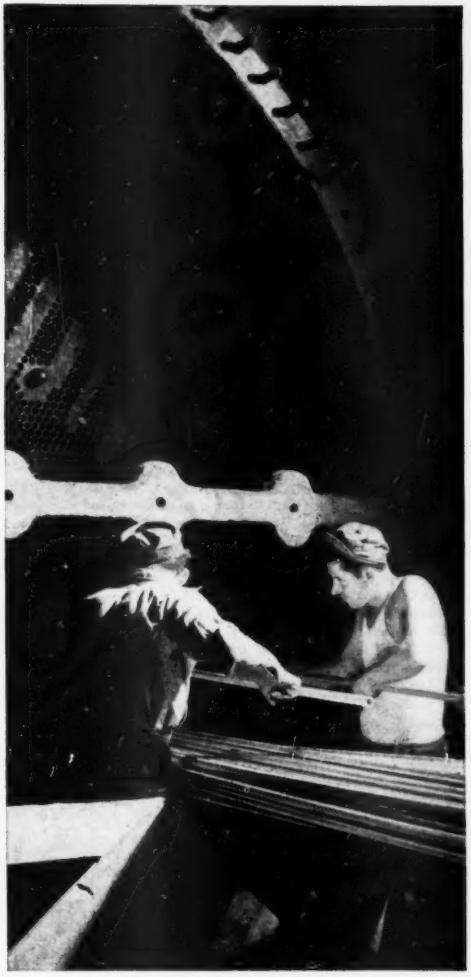
CONDENSER TUBES

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company

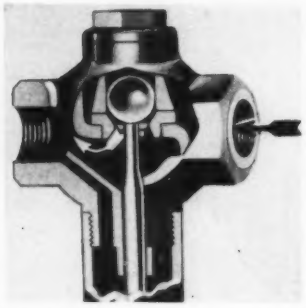
In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*



Retubing with Arsenical Admiralty to Serve a New England Industrial Area

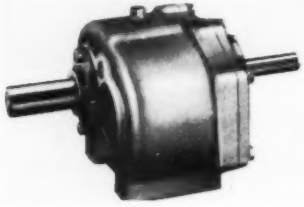
Arsenical Admiralty 439 Tubes were chosen for this recent retubing job, to combat the corrosive effects of a combination fresh and salt water coolant. The 2-pass condenser has a 29,000 sq. ft. cooling surface and serves a 25,000 kw generator. 5,600 tubes, with a weight of 65,000 lb. will go into the condenser. Utility station supplies power to an important New England industrial area.

NEW PLANT EQUIPMENT



Ball Valve E101

BALL INNER-VALVE CONSTRUCTION appears in all valves of the Klipfel 400 series for applications that require accurate regulation of steam, water, air or gas at inlet pressures less than 250 psi, reduced pressures below 150 psi, and where the reduced pressure must be adjusted frequently. The 400 series valves are single seated and actuated by a rubber diaphragm. When off the seat the ball is free to turn so all parts are exposed to the scouring action of the flow. Wear is evenly distributed. Ball is stainless steel, forged and heat treated for extreme hardness and accurately ground to perfect groundness. Seat is also stainless steel, but of a different analysis. **Klipfel Mfg Co, Div of Hamilton-Thomas Corp, Hamilton, Ohio.**

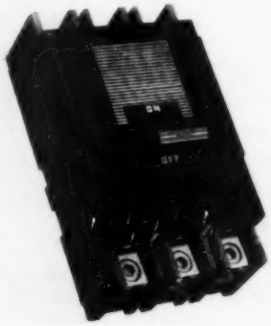


Two-Speed Drive E141

A TWO-SPEED AUTOMATIC TRANSMISSION UNIT provides wide range of speed ratios. It consists of two overrunning clutches, one engaging in a clockwise and the other in a counterclockwise direction. These are arranged so that by reversing the motor, two speeds are provided, one at 1 to 1 ratio and the other at a preselected speed reduction of the output shaft without changing its direction of rotation. Reversing can be done by a pushbutton, limit or timing switch. Units are built for up to 50-hp motors. Transmission is particularly adapted to machine-tool drives, but can serve on all types of special machinery in the chemical, process and service industries. **Western Mfg Co, 3400 Scotten Ave, Detroit 10, Mich.**

Stainless-Steel Pumps E143

SINGLE-STAGE STAINLESS-STEEL PUMPS resist corrosion in process work in refineries, distilleries, and chemical, synthetic-rubber, food processing plants. The pumps have a capacity of 2 to 180 gpm and 0 to 400-ft head of water. Pump has only one moving part with no metal-to-metal contact. Self-venting, the pump will not vapor bind. **Roy E Roth Co, Rock Island, Ill.**



Circuit Interrupters E132

LIKE A CIRCUIT BREAKER in appearance but without thermal or magnetic trip features, this circuit interrupter is designed for locations where space is limited and a local disconnecting means is necessary.

Cast-iron enclosures are available in weatherproof, dust-tight, dust-resisting and explosion-resisting types. **Square D Co, 6060 Rivard St, Detroit 11, Mich.**

Electric Hoist E146

MADE IN CAPACITIES from 1000 to 20,000 lb, these hoists have all-steel construction and gear train, preformed wire hoists rope and swaged-on rope fittings. Other construction features are ball bearing, fully enclosed NEMA motors, splined connections, grooved steel rope drum, jaw brake, rabbeted male and female frame connections, pushbutton controls, roller bearings and safety limit stop. Furnished in lug, hook, plain, or geared trolley (mounted crosswise or parallel to runway beam) 4-part single reeve, close headroom, base mounted, and with motor-driven trolley. Built for 220-v, 3-phase ac motor that can be reconnected for 440 v. It can also be had for 115 v and 230 v dc and for other voltages and frequencies in either 3-phase or 2-phase applications. **Wright Hoist Div, American Chain & Cable Co, York, Pa.**

Squirrel-Cage Motor E128

CALLED DESIGN X, this new line of across-the-line start induction motors is designed for direct coupling to 514, 600 and 720 rpm air compressors. Starting kva is 20% lower than the present NEMA design B, low-kva normal-torque squirrel-cage induction motor.

Motor is available in ratings between 60 and 250 hp at the 60-cycle speeds mentioned above. **Electric Machinery Mfg Co, Minneapolis 13, Minn.**

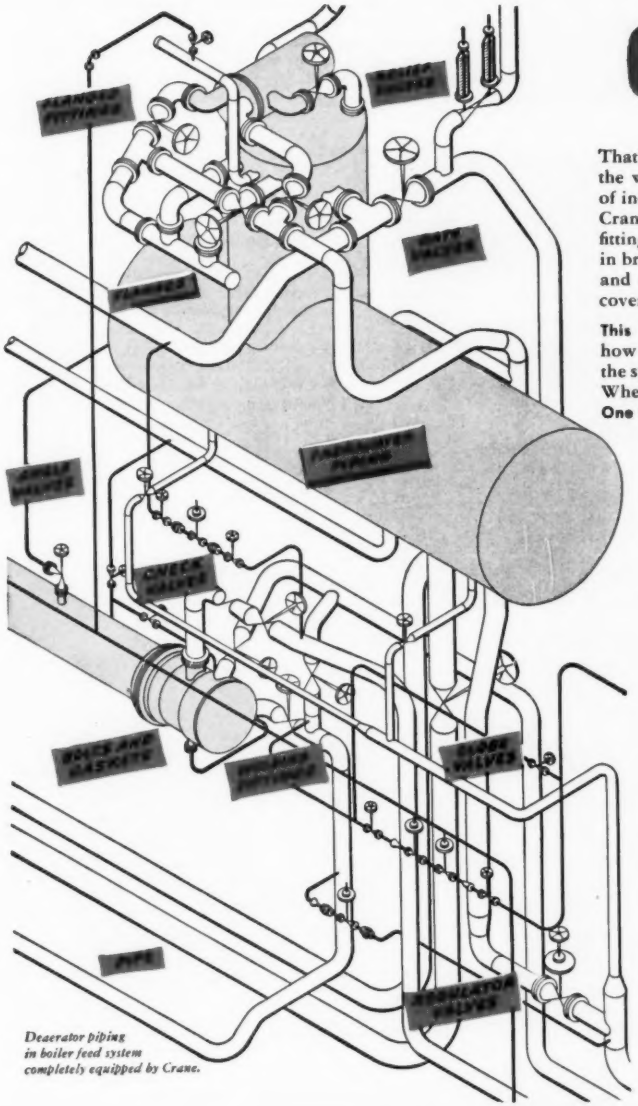
Oil Purifier E130

MAXIMUM CAPACITY of this refill-type oil purifier exceeds 2100 gph of 50-ssu color-clean oil on continuous circulation. Seven filtering units are mounted on center tubes within the purifier's steel shell.

Each filtering unit has a perforated steel

Use convenient reply cards on page 198a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.

Everything in piping . . . for every need . . . on one order to CRANE



Deaerator piping in boiler feed system completely equipped by Crane.

ONE SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY

That's the kind of service you get from Crane, the world's leading manufacturer and supplier of industrial piping equipment. "Everything" at Crane includes an unequalled selection of valves, fittings, fabricated piping, pipe and accessories—in brass, iron, steel and alloys. One catalog . . . and one order to your nearest Crane Branch cover whatever is needed for the job.

This Deaerator Piping, for example, illustrates how completely Crane supplies everything for the system, regardless of the fluids to be handled. When you standardize on Crane, you depend on **One Source of Supply** broad enough to simplify every piping procedure. You get better installations . . . avoid needless delays . . . by placing **Undivided Responsibility** on Crane for materials. And for **Highest Quality** in every piping item, specify Crane Quality—unsurpassed for more than 90 years.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

***FOR TOUGH STEAM SERVICES** up to 750 deg. F., and for water, oil, air, gas and other non-lubricating liquids up to 500 deg. F., Crane recommends No. 47XR 150-pound Cast Steel Wedge Gate Valves. Designed for tight seating with long-lasting Exelloy to Nickel Alloy. Screwed, flanged or welding ends. Sizes: 2 in. and larger. See your Crane Catalog, p. 304.*

EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

CRANE

FOR EVERY PIPING SYSTEM

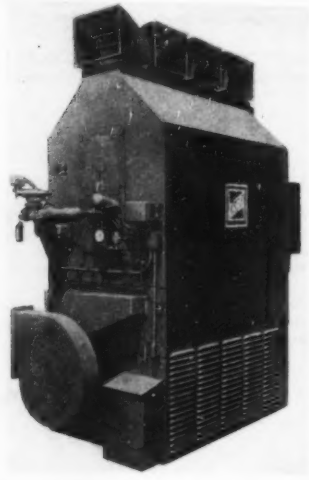
basket containing a cloth bag with specially processed fuller's earth. Entirely automatic in operation, the new purifier has no moving parts and requires no extra labor to operate. **Honan-Crane Corp, 962 Sixth St, Lebanon, Ind.**

Oil Burner E124

GUN-TYPE, positive-pressure oil burner has an exclusive oil-and-air regulation feature that, its manufacturer says, gives a straight-line efficiency through full-load range. Air control openings have been set in the outlet side of the blower so the positive pressure prevents lint from plugging up air supply. **Armstrong Furnace Co, Columbus 12, Ohio.**

Car Thawer E116

SHEET-METAL, trough-type thawing unit sits between railroad car rails. Waste, No. 2 fuel oil, or kerosene, is poured into the trough and ignited. Entire burning surface gives off heat across width of the car. Melted water drains off from the car on either side of trough. **J C Corrigan Co, 41 Norwood St, Boston 22, Mass.**



Space Heaters E118

DUAL-FUEL direct-fired space heater can be converted from oil to gas or vice versa in about 10 min. Combination burner comes in output capacities ranging from 400,000 Btu per hr to 2,000,000. Firing tube is sized to accommodate both gas and oil burners. A metal box attached to the side serves as a storage space for the unused burner. Combustion chamber is stainless steel and requires no refractory lining.

Air from the floor enters through louvers in heater base, passes over two staggered banks of economizer tubes carrying gas from the combustion chamber to the vent stack. The air sweeps the stainless-steel combustion chamber and discharges at about 2000 fpm. Each heater handles about 11,000 cu ft of air per million Btu. **Dravo Corp, Fifth and Liberty Ave, Pittsburgh 22, Pa.**

Differential Relay E139

OPERATING PRINCIPLE of this relay uses current transformer secondary voltage rather than current. Hence application requires only simple arithmetical calculations, permitting use of published data on ct's without need for saturation phenomena calculation.

New relay is sensitive to internal (bus) faults and definitely insensitive to external feeder faults. **General Electric Co, Schenectady 5, N. Y.**

Soldering Tools E122

LIGHT-DUTY, portable, resistance-heating soldering iron can heat ½-in. copper tubing to soldering temperature in 40 sec using 40-60 solder. The 450-watt *Thermo Grip* measures 9½x6x8¾ in., including storage space for attachments, and weighs only 16 lb.

When the soldering iron touches the work the secondary power circuit is complete. A thumb switch permits close heat control. There are two soldering heats, high—5.3 v, and low—4.2 v. A pilot light indicates when current is on and an "on-off" switch disables the power supply. **Ideal Industries, Inc. Sycamore, Ill.**

Low-Voltage Control E134

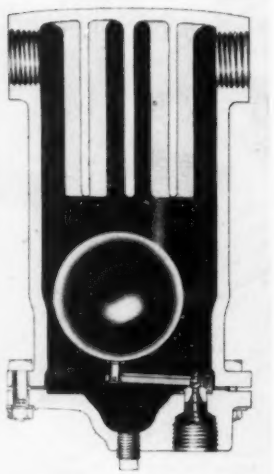
ALTHOUGH DEVELOPED for remote control of lighting and appliance circuits, the system may be adopted for service with alarm and signal systems, yard and night lights and sensitive control elements on machinery.

Nucleus of system is the small remote-control relays that can be installed in the knockout of the nearest outlet box. Feed to the relay coil circuit is from a step-down transformer. Individual relays are controlled by any number of conveniently located switches operating on the 24-v system. **Square D Co, 6060 Rivard St, Detroit 11, Mich.**

Dust Collector E110

SELF-CONTAINED, portable, filterless dust collector handles up to 2300 cfm of air with 8600 fpm velocity, at 4.5 in. static suction for a 7-in. pipe inlet. Model 20V30, a cyclone separator, employs a paddle-wheel fan driven by a 3-hp motor to draw air into separator; the clean air is discharged through an 8-in. flanged outlet at top.

Floor size of a complete unit is 22 by 40 in. Over-all height is 56 in. and shipping weight 400 lb. To facilitate installation, units come with a variety of standard-sized inlets: single 7 in., single 6 in., double 5 or triple 4 in. **Aget Detroit Co., Main at Washington, Ann Arbor, Mich.**



Air-Line Trap E97

SERIES 430 semi-steel combination separator trap removes entrained moisture and condensate from air-supply lines. Device can also be used on steam and gas service. It comes in five sizes from ½ to 1½ in., good

Use convenient reply cards on page 198a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, E, and number, as shown on the items above.

SEE REVERE

FOR CONDENSER TUBES AND PLATES

EXPERIENCE has proved that in a majority of installations Revere Admiralty Metal condenser tubes, inhibited to resist dezincification, will give long, satisfactory and economical service. However, Revere also makes tubes in Cupro-Nickel, Revalon (aluminum brass), Red Brass, Muntz Metal, Arsenical Copper, and Copper, thus enabling you to select the Revere Metal or Alloy best suited to meet your operating conditions.

In addition, Revere manufactures pipe and tube in copper and brass for general piping purposes, and electric welded steel tube.

Revere condenser plates can be had in a number of alloys in squares, rectangles, circles, half-circles, segments, and special patterns. These plates are flat, dense, free from blow holes or other imperfections, accurate in gauge, and are easily machinable.

As each condenser, heat exchanger or other piece of equipment using tubes and plates presents an individual combination of conditions, no blanket recommendations are possible. Among the factors to be considered are: chemical and impingement attack, velocities, pressures, temperatures, air entrainment, suspended solids. Should short tube life or other circumstances lead you to question your present practices, the Revere Technical Advisory Service will gladly cooperate with you in making thorough field and laboratory studies, to assist you to determine the most serviceable and economical alloys.

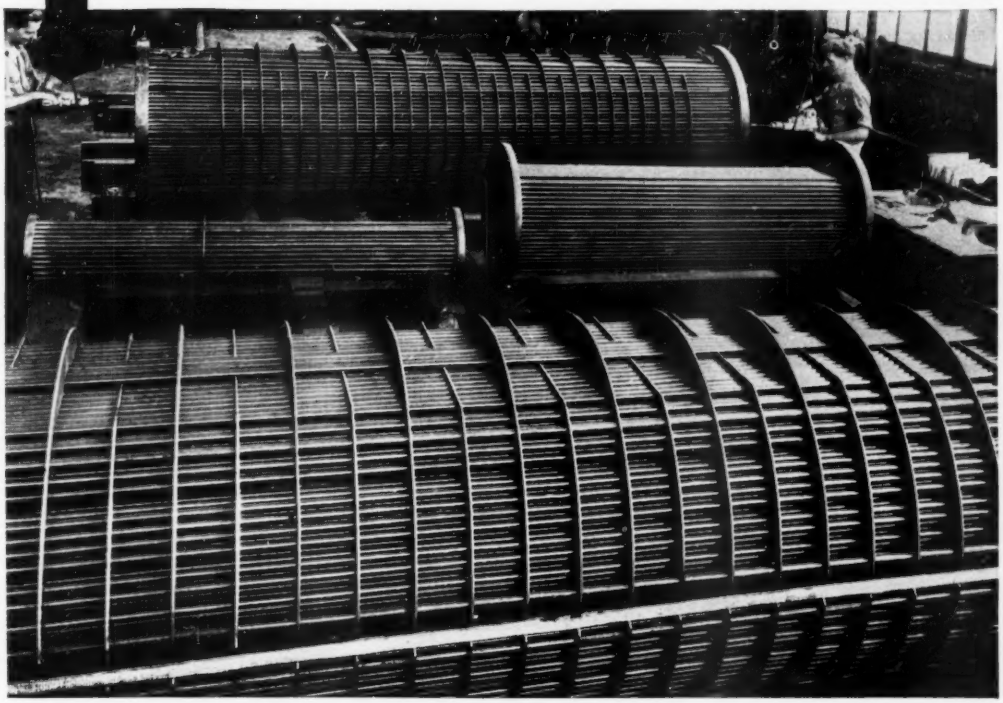
REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities, Distributors Everywhere.



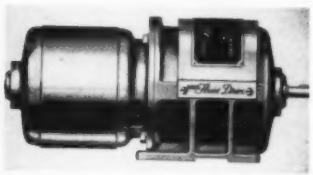
NEW EQUIPMENT CONTINUED

for working pressures up to 150 psi on the ½- and ¾-in. sizes, and up to 200 psi on the 1-, 1¼- and 1½-in. sizes. **Clark Mfg Co, 1830 E 38th St, Cleveland 14, Ohio.**

Power Supply E127

COMBINED dc and ac power supply unit is suitable for testing and calibrating instruments, meters, relays and for general servicing where several dc and ac power supplies are needed. Unit is enclosed in a metal cabinet, 11x21½x15 in. with a standard 19-in. panel for optional relay rack mounting. There are five ac channels ranging from zero to 1000 v and up to 250 ma. Six dc combinations provide voltages up to 460 v and 250 ma with some of the dc ranges filtered.

Device saves work and time usually connected with rigging up components of a power supply for testing or experimental work. **Electronicraft Inc, 5 Waverly Pl, Tuckahoe 7, N. Y.**



Fluid Drives E140

A HYDRAULIC electric power unit consists of an electric motor and a hydraulic drive combined in a single assembly. The motor is mounted directly on the drive, which is available in sizes up to 20 hp. Each unit has standard NEMA mounting bolt-hole dimensions so it can replace a standard motor of comparable horsepower rating and speed. Unit permits the motor to start without load and to pick it up gradually as speed increases, which eliminates necessity of overmotoring on hard-starting applications. When overload exceeds a certain amount the hydraulic unit slips and relieves the motor and driven machine. Amount of overload on motor can be adjusted by changing the oil level in the hydraulic drive. The units are applicable to a wide range of industrial-machinery drives. **American Blower Corp, Detroit 32, Mich.**

Stud Puller E98

SERIES A-80 STUD PULLER has built-in ratchet action for operation in close quarters. It has a capacity of ¼ to ½ in. stud. In operation, three jaws automatically close and grip the stud when pressure is applied. Device pulls a ½-in. stud with less than 1-in. clearance between stud and surrounding obstructions, and operates equally well on long or short studs. Long studs can run out the handle hole, and stud puller can then be turned with a wrench instead of conventional handle. **Snap-On Tools Corp, Kenosha, Wis.**

Rigid Coupling E149

TAPER-LOCKING RIGID COUPLING is built for conveniently connecting the ends of two shafts with the firmness of a shrunk-on fit, but is easy to disengage. Tightening or loosening is done by two setscrews. Coupling has a male and female joint and is machined all over. It is available in sizes up to 5 in. **Dodge Mfg Co, Mishawaka, Ind.**

Electronic Motor Control E145

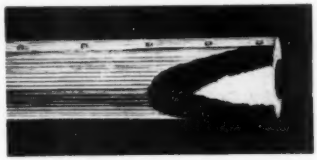
THY-MO-TROL DRIVE, available in ratings through ½ hp, utilizes a simplified half-wave circuit to provide dc flexibility from ac power. It is designed to provide, by the turn of a knob at a single-control station, smooth stepless speed control on small lathes, grinders, drill presses, conveyors, pumps, packaging equipment, and paint and varnish mixers. The drive operates from 220-v, 60-cycle ac, but for other voltages a suitable anode transformer is available. It has a 20-to-1 speed range from 1725 to 86 rpm. It is furnished in either the non-reversing or the reversing type, the latter being equipped with a separate magnetic reversing switch.

Designed for constant-torque loads, under normal conditions the drive has good speed regulation from no load to full load. Speed may be preset, or varied during operation and under load. Dynamic braking permits quick stopping. With normal industrial voltage fluctuations the drive will operate satisfactorily, although it does not compensate for changes in line voltage. Maximum tube life is obtained when the voltage fluctuates no more than 5%. **General Electric Co, Schenectady, N. Y.**

Humidifier E111

INDUSTRIAL HUMIDIFIER, designed for spaces between 2500 and 15,000 cu ft, vaporizes up to one-half gallon per hr. A bottom water-filled pan in base of Walton Junior humidifier has a float-control valve for regulating water level. A hollow copper tube rotates in this water and forces a thin stream of water onto a disk revolving at 3450 rpm. A circular copper comb in path of this water stream atomizes it into a fine spray.

On the bottom of rotating copper disk are small blades that set up a turbulence in the air within humidifier unit. This turbulent air stream catches up finer droplets of moisture coming off the disk and carries them out into the space under humidification. **Abbeon Supply Co, 58-10 41st Drive, Woodside, New York, N. Y.**

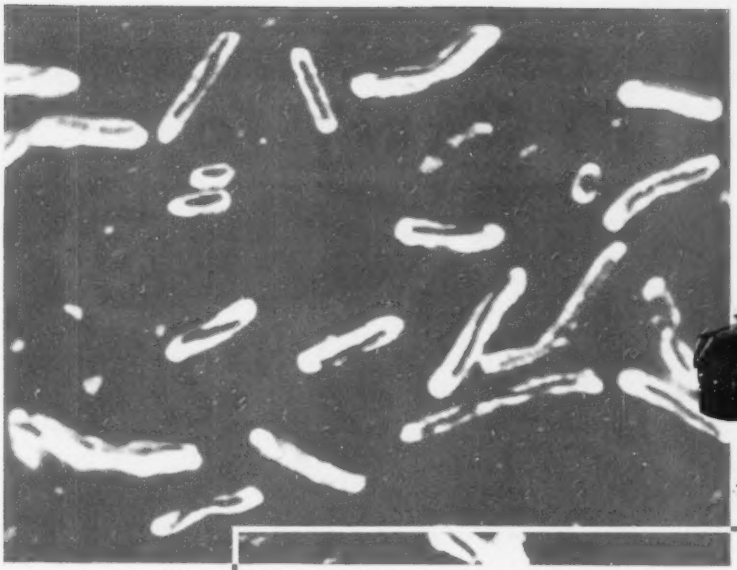


Pipe Jacketing E106

ALUMINUM JACKETING is designed for the protection of industrial insulated pipe lines. It is made of light-weight aluminum sheet, corrugated for extra strength and easy application. Jacketing comes complete with attached moisture barrier, consisting of 70-lb kraft paper fully impregnated with special asphaltic compounds, and coated on both faces, with a sealing mixture of Gilsonite, resins, waxes, and special asphalts.

(*Continued on page* 148)

Use convenient reply cards on page 198a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.



Left—Microphoto of Aerobacter Aerogenes, one of the slime-forming micro-organisms frequently found in water systems, and controlled by the Nalco System. Photos in Nalco Laboratories.

FORMULA FOR SUCCESSFUL SLIME CONTROL

SLIME control in cooling towers, ponds, pipes and equipment requires consistent, careful attention to details. Here is a proven formula for successful slime control which will cut time and cost expenditures to a minimum in your plant:

- Identify slime-forming organisms to be controlled.

  A NALCO SERVICE

- Determine the best types of treatment to be used.

  A NALCO SERVICE

- Locate, by detailed survey, the proper points of application.

  A NALCO SERVICE

- Provide consistent supervision to check application and effectiveness of treatment.

  A NALCO SERVICE

Nalco Field Representatives and the modern scientific facilities of the Nalco Laboratories are at your service to put this formula for successful slime control into practical operation in your plant. Write for details today.

NATIONAL ALUMINATE CORPORATION
6222 West 66th Place • Chicago 38, Illinois

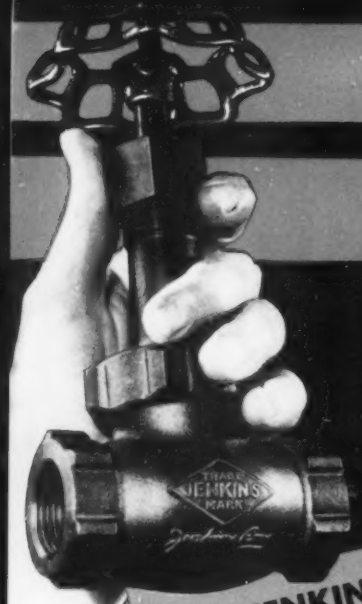
Canadian inquiries should be addressed to Alchem, Limited, Burlington, Ontario

THE nalco SYSTEM

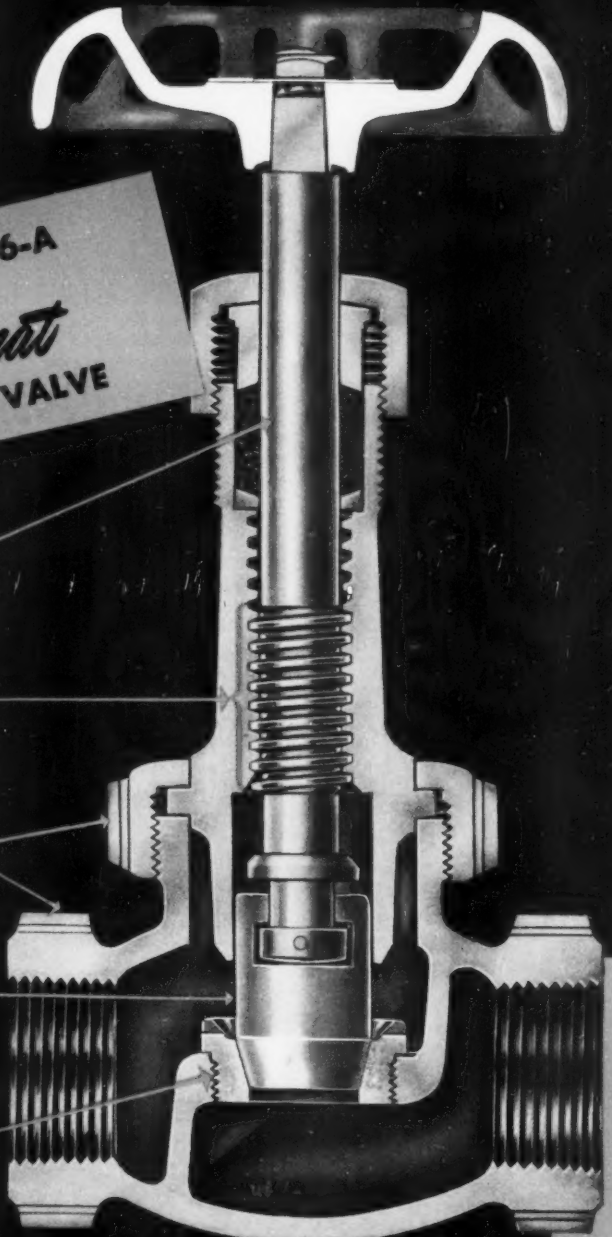
. . . Serving Industry through Practical Applied Science

IT'S NEW! . . .

IT'S JENKINS ANSWER



JENKINS FIG. 976-A PLUG TYPE *Armor Seat* BRONZE GLOBE VALVE



NEW "TUFFARD" SPINDLE Aluminum bronze of tensile strength exceeding 65,000 lbs.—tough to take stresses, *hard* for long wear. Bigger in diameter—more strong threads.

MORE THREADS, LESS WEAR Additional threads in bonnet and on spindle assures full thread engagement—open or closed—less load, less wear per thread.

NEW STURDY LUGS Flat-faced, V-shaped lugs on union bonnet ring and body ends permit firm fit and grip of open end, pipe, or monkey wrench, withstand repeated disassembly.

NEW SLIP-ON, STAY-ON PLUG Simple design with T-slot for engaging spindle head is stronger, trouble-free, permits free flow. Mirror-finished bevel assures perfect mating with seat ring.

500 BRINELL ARMOR SEAT DEFEATS TOUGHEST VALVE ENEMIES Plug and Seat Ring of Jenkins JX500 special alloy stainless steel—heat treated to 500 Brinell hardness and extraordinary ductility—lapped together to a mirror finish. Unaffected by throttled steam, resists galling, abrasion, erosion, and corrosion.

300 LBS. STEAM 600 LBS. O.W.G.

IT'S A DOZEN WAYS BETTER!

TO VALVE-KILLING SERVICES!

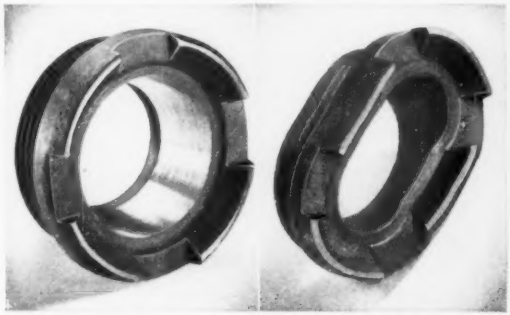
BUILT TO BREAK RECORDS FOR LONG LIFE

Now, for the worst valve-killing services, you can specify the new Jenkins Fig. 976-A with complete confidence that it will set new economy records. Compare it, part for part, and you'll agree it's as nearly wear-proof, trouble-proof, and maintenance-free as any stock valve can be.

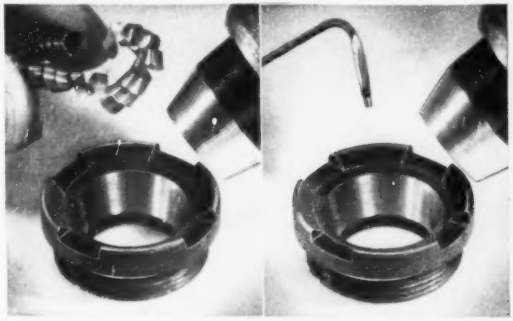
Use the new Fig. 976-A to safeguard your production against shutdowns due to valve failure. Use it in the most severe services you have,—pressure regulation, steam control by-pass lines, temperature regulation, bleeds, drips, and drains, soot blowers, or any close regulation of steam. Use it where throttled steam threatens wire drawing, where entrapped pipe chips, scale, or rust tubercles are a problem.

Check over the new features indicated here—only a few of a dozen ways Jenkins Engineers have made this new valve unrivaled for endurance and economy. Then get the complete story,—in a new folder jam-packed with reasons why the new Fig. 976-A is your best buy in plug-type valves. Send the coupon today.

Jenkins Bros., 80 White Street, New York 13; Bridgeport, Conn.; Atlanta; Boston; Philadelphia; Chicago; San Francisco. Jenkins Bros., Ltd., Montreal.



TAKES 18,340 LB. LOAD WITHOUT CRACKING *Compare the Jenkins JX500 Seat Ring (left) before and (right) after being deflected over 37% by a nine ton load. Not a sign of fracture! That's proof of its super toughness!*



SMASHED PIPE CHIPS, WIRE LEAVE NO SCARS *Chips from a standard steep pipe (left) and 1/16" wire rod having a Brinell hardness in excess of 300 were crushed between the new Jenkins JX500 Plug and Seat Ring without leaving a scratch or dent. That's proof of super hardness!*

LOOK FOR THIS TRADE JENKINS MARK DIAMOND MARK

SINCE Jenkins Bros. 1864

JENKINS VALVES

Types, Sizes, Pressures, Metals for Every Need
Sold through Reliable Industrial Distributors everywhere

GET COMPLETE DETAILS —IN THIS NEW FOLDER

MAIL COUPON TODAY

JENKINS BROS., 80 WHITE ST., NEW YORK 13

Please send Armor Seat Valve folder — Form 193

Name .....

Company .....

Address .....

POWER'S DATA SHEETS

Number 200

How to Figure Duct Weights

The chart below gives an easy way to figure duct weights when using standard-gage galvanized steel. Enter the chart with the indicated dimensions on the bottom scale, follow up to inclined curve of proper gage value, read answer left for rectangular ducts or read right for circular ducts.

Example 1: What is the weight of 35 ft of 36x24-in. 22-gage galvanized-steel duct?

Add 36 + 24 = 60 in. Find ordinate on bottom scale and read up to curve for 22 gage. On left scale find 12.5 lb per ft. Total weight = 12.5 × 35 = 437.5 lb.

Example 2: What is the weight of 40 ft of 90-in.-diameter 18-gage galvanized-steel ducts?

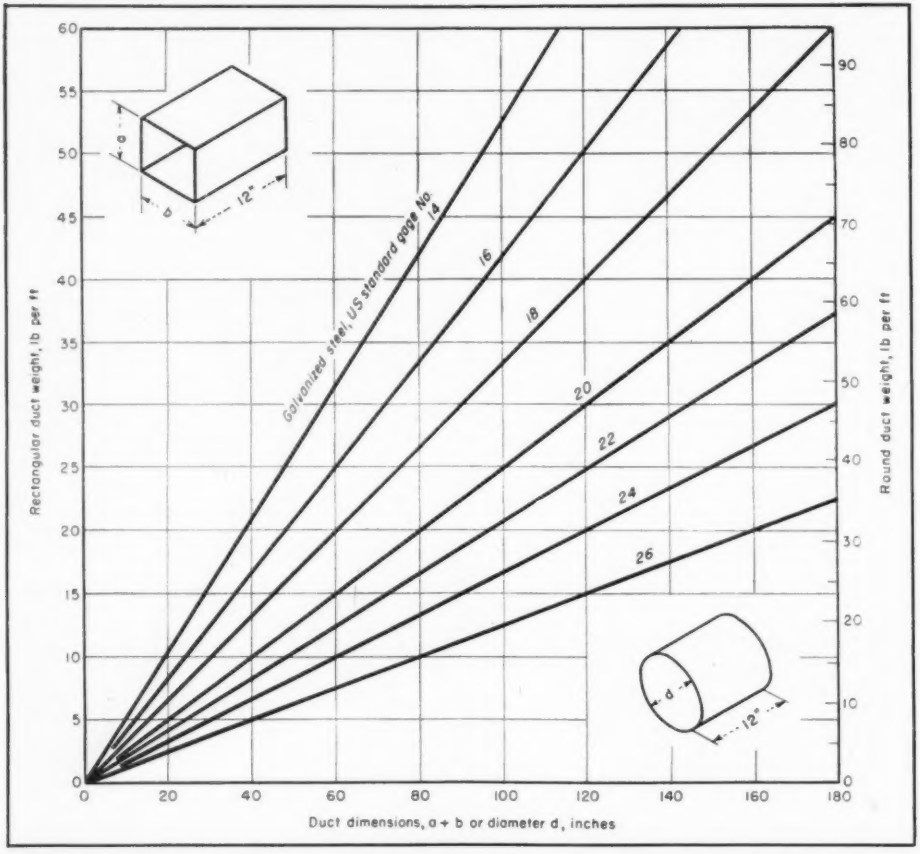
Enter chart at 90-in. on bottom scale and follow up to 18-gage curve and read 47.1 lb per ft on right-hand scale. Total weight = 47.1 × 40 = 188.4 lb.

Wastage and bracing should be added to above figures to find total weights when necessary. These usually run about 15% of total duct weight.

By Tyler G Hicks

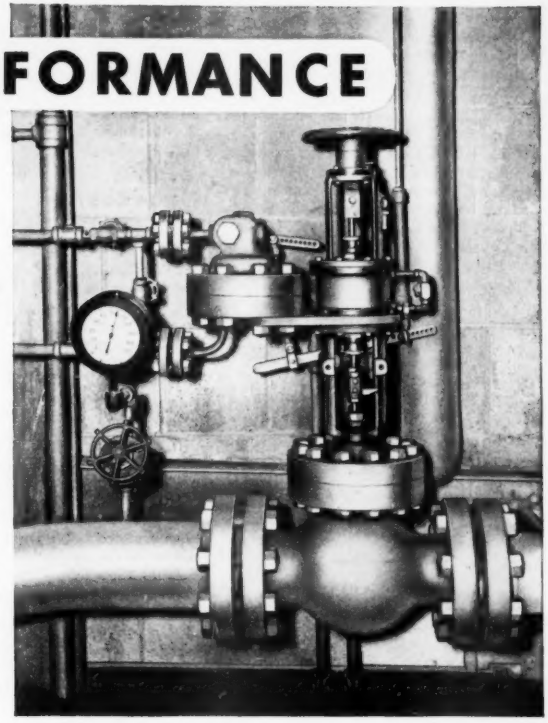
Recommended Duct Gages

U.S. standard gage No.	Round duct diameter, in.	Rectangular duct width, in.
26	6 to 19	4 to 18
24	20 to 29	19 to 30
22	30 to 39	31 to 60
20	40 to 49	61 to 118
18	50 and over	120 and over



POWER

3-YEAR PERFORMANCE *Sold* 3 MORE FLOWMATICS *at* CALCO



Installed in 1942 at the Bound Brook, New Jersey, plant of the Calco Chemical Division of American Cyanamid Company, this COPES Flowmatic Regulator gave good results from the start—even before combustion was under fully-automatic control—on the 900-psi Riley Type RP boiler rated at 200,000 pounds of steam per hour.

Three years later, Calco installed three more COPES Flowmatics to replace another type of feed water regulator on three older 480-psi boilers, each with maximum capacity of 100,000 pounds per hour. Only routine maintenance has been needed to keep all four COPES Flowmatics giving optimum performance since installation.

COPES Flowmatic Control gives you close control of boiler water level, regardless of range or speed of load fluctuation. Entirely indepdendent of instruments and other controls, it remains on full automatic during periods when they must be out of service for periodic maintenance. Simple and rugged, it handles emergency conditions as safely and dependably as it does normal operation.

These are the reasons why COPES Flowmatics have been ordered for more than 2800 boilers with pressures up to 1825 psi. Why you will find users in all of the 48 states and in 43 other countries. Why operation of your modern high-duty boilers will be safer and more efficient with two-element COPES Flowmatic Control—designed and built for your individual requirements, to fit any piping layout and operating preference.

NORTHERN EQUIPMENT COMPANY
391 GROVE DRIVE • ERIE, PENNSYLVANIA
BRANCH PLANTS in Canada, England, France, Austria, Italy
☆ *Representatives Everywhere* ☆

The story of COPES at Calco is told in Performance Report 481. Write for your copy—on your letterhead, please.

COPES

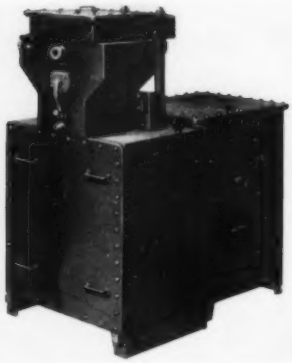
COPES

Headquarters for . . .

Boiler Feed Water Control . . . Excess or Constant Pressure Control, Steam or Water . . . Liquid Level Control . . . Balanced Valves . . . Desuperheaters . . . Boiler Steam Temperature Control . . . Hi-Low Water Alarms.

NEW EQUIPMENT CONTINUED

Aluminum jacket needs no painting and can be reused when lines are removed. It is said to have a life of 20 years. Jacketing comes in rolls 4 ft wide and 100 ft long. Each roll is wrapped individually in heavy corrugated cartons and weighs about 63 lb. **Childers Mfg Co, 625 Yale St, Houston 7, Texas.**



Motor Starter E135

THIS STARTER, known as the *Valimitor*, provides unlimited short-circuit protection and may be used in Class I, Group D hazardous locations. The combination starter and disconnect switch is suitable for service with squirrel-cage, synchronous and wound-rotor motors for 2.3 and 4.6 kv service.

An oil disconnect switch permits isolating the starter from the power lines. Units are built for motors up to 600 hp at 2.3 and 4.6 kv, 60-cycle service. Maximum rating is 300 hp at 2.3 kv and 250 hp at 4.6 kv. **Electric Controller & Mfg Co, 2700 East 79th St, Cleveland 4, Ohio**

Welding Control E121

LOW FREQUENCY, electronic welding control makes possible welding of scaly or rusty steel and can also be used for welding brass or aluminum. The control is a frequency converter that converts current at line frequency to lower frequency through electron tubes. Complete unit consists of three components: (1) a sequence panel to coordinate electrical functions of the control with mechanical functions of welder (2) a frequency-control circuit to transform line frequency to a lower frequency (3) a weld timer to time duration of welding current.

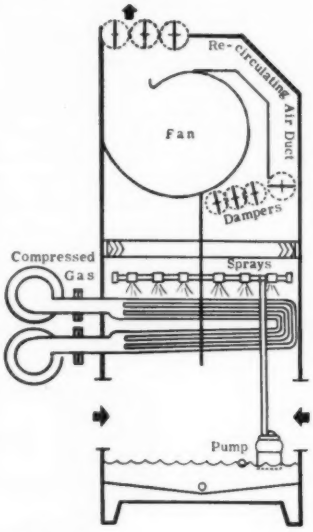
The control is designed for connection to a resistance welding machine having a specially constructed center-tapped primary. The current passes in one direction through the primary for four half cycles and then reverses for four half cycles to produce a low frequency ac on the transformer output. **Westinghouse Electric Corp, P O Box 868, Pittsburgh 30, Pa.**

Electric Boilers E113

PORTABLE, under 100 lb, electric boilers have a steam-generating capacity of about 45 lb per hr. The *Speedylectric* comes in three pressure ranges: Series 512, 100 psig; 612, 200 psig; and 712, 250 psig. All operate from 220 v, single phase, 60 cycle for 15-kw maximum rating. They can work from 110 v supply, however, but not at maximum rating. They measure 14x21x35 in. high. **Livingstone Engrg Co, 100 Grove St, Worcester 5, Mass.**

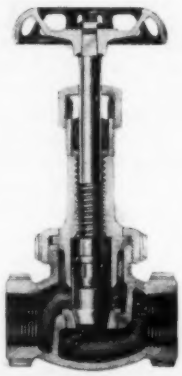
Insulating Bushings E147

ALL-BAKELITE INSULATING BUSHINGS have increased strength and durability. Rounded edges protect wire insulation during pulling and in service against grounds and short circuits. Clean, deep threads and ribbed outer surface make installation easy. When desired, bushings are furnished with caps that keep out plaster and other refuse until installation is completed. Sizes range from ½ to 6 in. **O Z Electrical Mfg Co, 262 Bond St, Brooklyn, N. Y.**



Aftercooler E105

AERO AFTERCOOLER dries compressed air or gas by cooling it to a temperature below dry-bulb temperature of the atmospheric air. Device does this by evaporating a recirculating water spray on surface of a coil through which compressed air passes, creating a temperature close to wet-bulb temperature of surrounding atmosphere. Protection against freezing is provided by a balanced wet-bulb control. A thermostat in the spray-water reservoir is set for a desired low-temperature limit at which it operates dampers to recirculate air stream internally around a division plate instead of drawing in fresh air. Manufacturer claims it consumes less than 5% of the cooling water required by conventional coolers. **Niagara Blower Co, 405 Lexington Ave, New York 17, N. Y.**



Bronze Globe Valve E69

FIG 976-A, BRONZE GLOBE VALVE, for 300 psi, is suited to severe services, such as pressure regulation, steam-control bypass lines, temperature regulation, throttling, bleeds, drips, drains, soot blowers, continuous blowdowns, and for services frequently found in dye houses, bleacheries, breweries, oil refineries, packing houses, etc. Valve features armor seat and *Slip-on, Stay-on* plugs. Plug and seat ring of *JX*-500, a special stainless-steel alloy, is heat treated to give proper hardness (500 brinell). Spindle is made of hard, tough aluminum bronze for corrosion resistance. Available in sizes ¼ to 2 in. **Jenkins Bros, 80 White St, New York, N. Y.**

Fluxes E125

FOUR RECENTLY ANNOUNCED FLUXES do the following: No. 3 brazes brass, bronze, steel, clean cast and malleable iron; No. 7 applies for high heat brazing of cast and malleable iron where base metal gets exceptionally hot; No. 5 for moderate heat brazing of cast and malleable iron and tinning dirty castings; No. 9 for fast welding of cast iron. **Victor Equipment Co, 844 Folsom St, San Francisco 7, Calif.**

(Continued on page 178)

Use convenient reply cards on page 198a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, E, and number, as shown on the items above.

...new handy selector for pump packings

If you're using reciprocating or centrifugal pumps . . .

If your packing seals against fresh or salt, hot or cold water, steam, oil, brine, ammonia or other fluids and chemicals . . .

If you want to know the correct packing for each application . . .

If you're interested in using fewer styles of packing to do the job . . .

. . . Then you'll want this new J-M Packing Selector to keep on hand.

This handy new packing selector gives you brief, specific data on ten popular styles of Johns-Manville Packings that serve over 90% of all pump packing applications . . . shows you where to use each style for greatest efficiency and economy of service.

Here's the quick, easy way to check on your pump packing efficiency . . . to find out about lower packing costs . . . to get higher efficiency and longer life from your packings. Use the coupon, or write for your copy today to Johns-Manville, Box 290, New York 16, N.Y.

JM PRODUCTS

Johns-Manville

PACKINGS & GASKETS

Johns-Manville
Box 290, New York 16, N. Y.

Please send me your packing selector for reciprocating and centrifugal pumps (PK-39A).

Name_____

Firm_____

Address_____

City_____ State_____

P-3

TECHNICAL BRIEFS

ENGINEERING DEVELOPMENT HERE AND ABROAD DIGESTED FOR BUSY POWER MEN

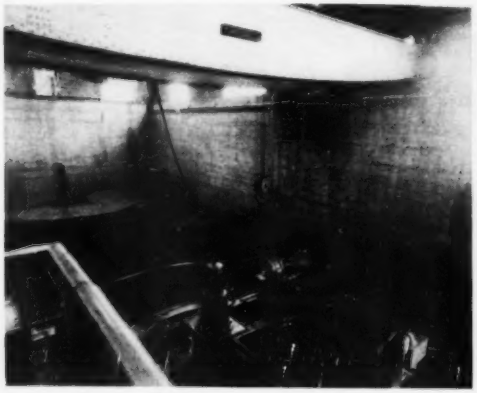
REVIEWED IN THIS ISSUE

MAINTENANCE, REPAIR
Repairing Hydro Adjustable-Blade Turbines by Welding
Studies of Flyash Erosion, Report of Locomotive Development Comm, BCR

HEAT TRANSFER
Cooling-Tower Analysis
Study of Three Tube Arrangements in Unbaffled Tubular Heat Exchangers
Aerodynamic Heating and Convection

PUMPS
Hydraulic Surges in Discharge Lines
Predicting Liquid Jet Performance
Elements of Graphical Solutions of Water-Hammer Problems

Directions for ordering papers are given on page 152



1 Driving unit mounted on top of generator turns generator and turbine at 1 1/3 rpm for machining the ring and shaft

2 Pneumatic spindle grinder, set in a supporting ring and on a swing arm, permits overhead grinding of turbine blades

MAINTENANCE, REPAIR

REPAIRING HYDRO ADJUSTABLE-BLADE TURBINES BY WELDING, *by Joel B Justin, Philadelphia, Pa., and Edward Davis, Indiana-Michigan Electric Co.* Methods of repairing adjustable-blade turbines by welding with stainless steel and using precast blade stainless-clad inserts are described. By using the 169-in. turbine as a boring mill, the throat rings were machined and preclad, preformed plates were welded in place. Also, by using the same turning equipment water-lubricated bearing sleeves were rebuilt with metal spray and machined in place.

About five tons of welding rod were used in repairing cavitation of 646 sq ft of the adjustable-blade turbines of the Kanawha Valley Power Co's hydroelectric plant at London, Marnet and Winfield. These major repairs requiring new blade inserts and stainless-clad plates were carried on during low-water period beginning in 1943, and were recently completed.

Plants at Marnet and London are identical. Put in service in 1935, both operate under a normal head of 24 ft. Each plant has two adjustable-blade turbines rated 7600 hp and 7250 hp, and one 6600-hp 6-blade turbine. The Winfield plant, which went into service in 1937, operates under a head of 26 ft. It has three 9200-hp adjustable-blade turbines. All nine units operate at 90 rpm.

Taken as a whole and considering the special setups for machining, heat treating and similar operations which were occasioned by the work being done on location, this project presents a remarkable example of what can be done in field maintenance. Some of the welding, that of welding the blade inserts, was unusual in that it was done in accordance with boiler-code requirements, including full heat treatment and gamma-ray inspection. While these features may be unnecessary, they were included to provide every possible protection because of the lack of a known precedent for such a job. This work performed in a shop at some future time will not require more than good, qualified welders.

Again, such features as machining the draft tube by converting the whole machine into a boring mill, and the technique employed to weld, machine and metal spray the shaft sleeve—a repair which will provide a sleeve giving 3 to 10 times the ordinary life—are unusual because they are commonly performed only in a large shop.

The advantage of low carbon and of columbium-stabilized welding rod cannot be overemphasized in obtaining a good job that resists cavitation. Likewise, a carefully planned technique of welding procedure must be developed and carried out with qualified welders.

At present most manufacturers are specifying shop welding of blades and their periphery before leaving the shop. Cavitation on adjustable-blade turbines is quite common, but can be controlled by stainless-steel welding. The runner's periphery is the most vital section as velocities are greatest here. Units repaired with full-size inserts show, after two years, only a small amount of cavitation and have not yet had to be repaired. It is believed that with careful inspection these turbines can now be kept repaired with a minimum of welding and outage time. *ASME Paper No. 48-F-1.*

STUDIES ON FLYASH EROSION, *by M A Fisher, Armour Research Foundation*

DUQUESNE LIGHT COMPANY'S Frank R. Phillips Power Station at Wireton, Pa. Units 2 and 3, now being constructed by Dravo, will more than triple the original 75,000 kw capacity of this key station serving the Pittsburgh area.

DRAVO
CORPORATION

DRAVO BUILDING, PITTSBURGH 22, PA.

Engineering Constructors of power plants, boiler plants, central stations, compressor stations, water pumping stations—fabricators and erectors of power piping—power and boiler plant equipment

PITTSBURGH · PHILADELPHIA · CLEVELAND · NEW YORK · DETROIT

and E F Davis Institute of Gas Technology. The Locomotive Development Committee of Bituminous Coal Research, Inc has been closely concerned with developing a coal-fired gas-turbine-driven locomotive. One of the chief difficulties anticipated, in the use of pulverized coal as a fuel for a gas turbine, is the possibility of serious erosion of turbine blades and other metal parts by the suspension of flyash in the hot combustion gases.

This paper describes the methods and techniques set up to record and evaluate erosion studies. *ASME Paper No. 48-A-53.*

To Obtain Complete Text

Material for these abstracts came from one of the following sources:

American Society of Mechanical Engineers annual meeting, New York, Nov 29-Dec 3, 1948. Papers are identified by initials *ASME* and paper No. Available at ASME, 29 W 39th St., New York 18, N. Y.

National Conference on Industrial Hydraulics, Chicago, Oct 20-21, 1948. Papers are identified by initials *NCIH*. Available through Armour Research Foundation, Technology Center, Chicago 16, Ill.

HEAT TRANSFER

COOLING TOWER ANALYSIS, *by Joseph Lichtenstein, The Tower Co.* The author feels the need for a cooling-tower equation that would permit determining performance from essential design features. Such a formula would enable comparisons, helpful in evaluating solutions, competitive cooling-tower designs, etc.

To arrive at such a design equation requires a method of analysis of existing over-all test data. This is attempted by substituting for the real tower a combination of prototype film and drop towers assumed to have the same performance as the real tower. A sample analysis of a typical tower is made in which the functions of each component part of the tower and its contribution to the total performance are evaluated.

The author defines the various terms used in developing his equations by a rather thorough breakdown of the elements in both the drop and the film tower. *ASME Paper No. 48-A-32.*

A STUDY OF THREE TUBE ARRANGEMENTS IN UNBAFFLED TUBULAR HEAT EXCHANGERS, *by O P Bergelin, E S Davis, H L Hull, University of Delaware.* Pressure-drop and heat-transfer tests of a medium viscosity oil in viscous flow across vertical tubes in three unbaffled exchangers make up the basis of a research program. The three once-through units have, respectively, equilateral triangular, in-line square, and staggered-square tube arrangements. In all other respects they are as nearly identical as possible.

Heat-transfer data for three bulk-oil temperatures and a constant, but lower, tube-wall temperature and both isothermal and nonisothermal pressure-drop data at three temperature levels are reported. The two staggered-tube heat exchangers provide greater heat transfer at a given pumping power loss than does the in-line arrangement in the region of viscous flow. But at higher velocities this superiority decreases. And in turbulent flow it may disappear. This latter is a confirmation of previous data. A correction for the effect of viscosity gradient upon friction during heat transfer is given but this correction does not allow for free convection or nonuniform flow. *ASME Paper No. 48-A-34.*

AERODYNAMIC HEATING AND CONVECTIVE HEATING TRANSFER—SUMMARY OF LITERATURE SURVEY, *by H A Johnson, General Electric Co, and M W Rubesin.* NACA Ames Laboratory, Moffett Field, Calif. The analytical and experimental information appearing in the literature for convective heat transfer at high velocities is summarized. Particular emphasis is given to heat transfer for submerged flow over flat plates, wedges, cones and cylinders with a single reference to flow in pipes. The evidence presented supports, as a fundamental heat-transfer relation, the modified Newton's Law of cooling. This law is then given in its equation form and various terms and coefficients are studied by themselves and in their relationship with others. *ASME Paper No. 48-A-39.*

PUMPS

HYDRAULIC SURGES IN PUMP DISCHARGE LINES, *by S Logan Kerr, consulting engineer.* Heavy hydraulic surges have occurred and severe damage has resulted in long conduits supplied by motor-driven centrifugal pumps upon failure of the power supply or upon sudden shutdown of the units. In other instances little or no surge occurred upon shutdown of the pumps.

Predicting water hammer in such installations becomes an important factor in equipment design and selection. Development and amplification of water-hammer theory, when related to actual field experience, have enlarged the available knowledge of the causes of heavy surges, and now permit the advance determination of such phenomena.

Analyses show that surges, resulting from electrical-power failures or from ordinary starting and stopping operations, are greatly influenced by a number of factors including flow velocity, profile of pipeline and physical characteristics of the pipe itself. Relation between pumping head and conduit length, as well as the ratio of the conduit's critical time to the time required for flow reversal, may determine whether surges will be dangerous. Type and operation of check valves used under various conditions and the methods of starting and stopping pumping units will affect the hydraulic surge in the discharge lines.

By using graphical methods, water-hammer calculations can be carried out before final design. Comparison of field tests and operating experience with advance computations confirms the reliability of this method of predicting surge conditions. *NCIH Paper.*

ELEMENTS OF GRAPHICAL SOLUTION OF WATER-HAMMER PROBLEMS IN CENTRIFUGAL-PUMP SYSTEM, *by A J Stepanoff, Ingersoll-Rand Co.* Since publication of *Symposium on Water Hammer,* by ASME in 1933, considerable progress has been made in developing the graphical method of solving water-hammer problems. Although based on the same fundamental relationship as the analytical solution, the graphical method does not require an exact knowledge of theoretical background. It gives a clear mental pattern of events that enable one to use it with confidence for solution of practical problems.

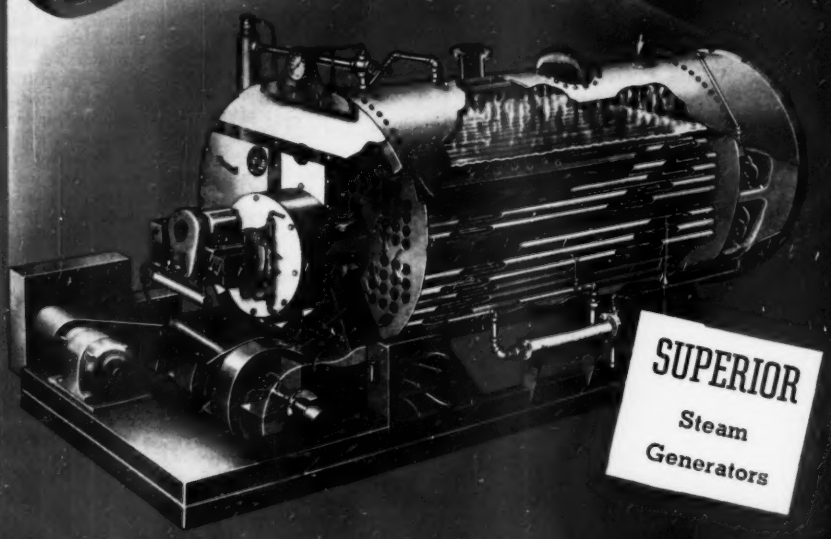
Early studies of water hammer were carried out almost entirely in connection with water-turbine applications. Water-hammer problems in the centrifugal-pump field are more numerous and varied, but because of the smaller size of the units the effects of water-hammer damage are generally repaired at a relatively low cost. The author presents water-hammer theory and the graphical method of solution in its simplest terms. This enables a pump engineer to recognize the conditions leading to water hammer, to estimate the possible maximum pressure rise, and, when necessary, to reduce the pressure rise to a safe limit.

Pressure rise due to water hammer can be minimized by reducing the rate of velocity in the pipe. This is accomplished by one or more of the following methods:

1. Design pipe systems for low velocity.
2. Use positively controlled valves

(*Continued on page* 170)

YOU CAN *See* THE DIFFERENCE



SUPERIOR
Steam
Generators

Obviously you can't actually see the 80% guaranteed thermal efficiency . . . but you CAN see the evidence of SUPERIOR design and construction which achieves the result.

You CAN see the built-in induced draft . . . the express design with ample heating surface. You CAN see the SUPERIOR Turret Burner for fully automatic operation with ALL grades of oil (gas or combination gas-oil if you prefer) . . . louvre-type dampers providing simple adjustment of air supply . . . the unusually large steam space (providing ample reserve capacity) . . . the large evaporating surface.

Through an engineer's eyes, it all adds up to Superior performance.

Superior Steam Generators are available in 10 sizes ranging from 20-500 b.h.p. for pressures up to 150 lbs. For complete details, write for Catalog 101.

Superior Combustion Industries, inc.

Factory Emmaus, Pa.
Executive Offices Times Tower, Times Square, New York 18, N. Y.

POWER NEWS

BUSINESS ITEMS • APPOINTMENTS • FOREIGN FIELDS
WASHINGTON NOTES • NEW DEVELOPMENTS • CONVENTIONS

Combustion Engineering And Superheater Merge

► Merger of Combustion Engineering Co and Superheater Co became effective on Dec 31, 1948, under new name of Combustion Engineering — Superheater, Inc.

The original Combustion organization was founded in 1914, its products including Type E, Type H and Coxe stokers. Subsequently it absorbed other manufacturers of fuel-burning equipment and several boiler companies, including the manufacturers of Heine, Walsh-Weidner, Casey-Hedges and Ladd boilers.

Superheater Co was organized in 1910 as Locomotive Superheater Co.

Following World War I, both Combustion and Superheater were identified with major new developments in steam generation. Combustion was chiefly responsible for the commercial development of pulverized coal firing of boilers, water-cooled furnaces and completely integrated designs of steam-generating units. Superheater pioneered superheater designs for higher steam pressures and temperatures.

Domestic manufacturing plants owned by the two companies occupy some 115 acres and are located at Monongahela, Pa.; Chattanooga, Tenn.; Chicago; East Chicago, Ind.; and St. Louis. Plants operated by subsidiary companies are located in Canada, England and France.

The companies do business outside the U.S.A. through representatives in the principal cities of Latin America and the Orient and through subsidiaries in Montreal, Mexico, Brazil, London, Sydney and Paris.

The two companies became affiliated in 1933. The new company will continue the world-wide activities of the present companies in manufacture and installation of steam generating and associated products, and such equipment as chemical recovery units for pulp mills, flash drying systems for a wide variety of materials; sewage incineration systems; mills for pulverizing products of the process industries.

Officers of the new company are: Frederic A Schaff, chairman of board and vice-chairman of executive committee; Samuel G Allen, chairman of executive committee; Joseph V Santry, president; Martens H Isenberg, executive vice-president; Harold H Berry, vice-president in charge of finance. Vice-presidents: Wilbur H Armacost, George D Ellis, Amaziah J Moses, John S Skelly, Otto W Strauss, Donald S Walker, Albert C Weigel, Arthur Williams. Secretary and assistant treasurer —Irving B Swigart. Assistant secretaries—Thomas F Morris and Francis J Dolan. Assistants to chairman—Thomas F Morris and Frank R Fitzpatrick.

NACA Unveils Largest Supersonic Wind Tunnel

► The world's largest supersonic wind tunnel, capable of producing winds of about 1500 miles per hour, has been unveiled in Cleveland by National Advisory Committee for Aeronautics. Features of the tunnel are an axial-flow air compressor with over a thousand blades; the most mechanical power ever placed on a single shaft by electric motor drive and the three largest slip-regulators yet devised.

Wind is created by the air compressor driven by three 29,000-hp electric motors hooked in tandem to a single shaft. The motors, which operate at 900 rpm, are the largest ever built to run at that speed. Designed and built by General Electric, the motors are wound-rotor 8-pole 6600-v induction motors using 3-phase 60-cycle power from standard lines.

Efficiency rating of the motors is about 97%. Special insulation on the motors is capable of carrying a temperature rise of 80 C at continuous rated load. Totally enclosed, the motors are fitted with water-to-air heat exchangers and axial-flow blowers for cooling.

Each of the three drive motors is governed by its own regulator with the regulator for the first one acting as a

(*Continued on page* 200)

COMING EVENTS

Mar. 2-6—Electric Assn of Kansas City, electrical exposition, Municipal Auditorium, Kansas City, Mo. Frank F Robinson, Exposition of Electrical Progress Assn, Kansas City 6, Mo.

Apr 11-13 — American Society of Lubrication Engineers, meeting, Hotel Pennsylvania, New York, N. Y. W F Leonard, secretary-treasurer, 343 S Dearborn St, Chicago 4, Ill.

Apr 11-14—National Assn of Corrosion Engineers, meeting, Netherland Plaza Hotel, Cincinnati, Ohio. A B Campbell, exec secretary, 905 Southern Standard Bldg, Houston, Texas.

Apr 18-20—Midwest Power Conference, Sherman Hotel, Chicago, Ill. Roland A Budenholzer, conference director, c/o Illinois Institute of Technology, 3300 S Federal St, Chicago 16, Ill.

Apr 19-21—American Institute of Electrical Engineers, meeting, Baker Hotel, Dallas, Texas. H H Henline, secretary, 33 W 39th St, New York 18.

Apr 21-23—New York State Society of Professional Engineers, convention, Hotel New Yorker, New York. Edward J Quirin, Frederic R Harris, Inc, 27 William St, New York, N. Y.

Apr 25-29—Oil and Gas Power Div., American Society of Mechanical Engineers, meeting and exhibit, Hotel Sherman, Chicago. Joseph M Clark, manager, 29 W 39th St, New York, N. Y.

May 12-13—Instrument Society of America, fourth annual spring meeting, Royal York Hotel, Toronto, Canada. Ed Grace, Instrument Society of America, Pittsburgh 12, Pa.

May 19-21 — Society for Experimental Stress Analysis, spring meeting, Hotel Statler, Detroit, Mich. W M Murray, Society for Experimental Stress Analysis, Box 168, Cambridge, Mass.

May 24-27—National District Heating Assn, 40th annual meeting, New Ocean House, Swampscott, Mass. John F Collins Jr, secretary-treasurer, 827 N Euclid Ave, Pittsburgh 6, Pa.

May 30-June 3—American Water Works Assn, meeting, Hotel Stevens, Chicago, Ill. Arthur T Clark, secretary-manager, Water and Sewage Works Mfrs Assn, 170 Broadway, New York 7.

No. 211 No. 800

Above left — Armstrong bottom inlet—top outlet series trap.

Above right — Armstrong No. 800 side inlet—side outlet trap.

PROOF THAT ARMSTRONG TRAPS PAY DIVIDENDS:

$26,119.62 FUEL SAVINGS after installing new heating system and individually trapping all mains, risers, coils and unit heaters with Armstrongs.—L. G. Balfour Co., Attleboro, Mass.

•

SAVE 3728 GALLONS OF FUEL OIL annually after installing Armstrong traps on kettles and other equipment. — Mary Lincoln Candies, Inc., Buffalo, N. Y.

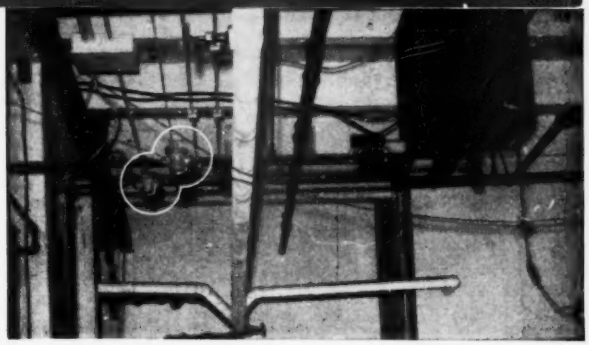
•

20% COAL SAVING at Norton Greenhouses, St. Paul, Minn., resulted after heating coils were individually drained by Armstrong "blast" traps with thermic air vents.

•

15% Fuel SAVING due to Armstrong traps at Sun-Ray Cleaners, Chicago, Ill.

FUEL BILLS TAKE A NOSE DIVE



When you Unit Trap with Armstrongs

Any plant operator or engineer may ask, "Why should I expect to save fuel if I invest in Armstrong Unit Traping?" The answer is simple:

1. *Armstrong traps can't leak steam*—the hardened chrome steel valve and seat are ground and lapped to a precision, steam-tight fit; they are water sealed at all times. When steam enters the trap, the bucket floats and closes the valve. Full steam pressure against the valve holds it closed—*tightly!*

2. *Non-productive radiation losses minimized*—with Armstrong traps on the job, the steam gives up more heat through the machine, less through the supply and return lines. Air and condensate is discharged as rapidly as it accumulates; heat transfer efficiency in the machine is greater; flow of steam in is more rapid; condensate is discharged at steam temperature—no "cooling legs" needed.

3. *Faster Production*—because Armstrong traps keep equipment HOT, drying, evaporating, cooking, heating and other processes are faster. It takes less steam when it takes less time to complete a heating cycle.

But, the "reasons why" make dull reading compared to the PROOF—see the column at the left. For recommendations and prices on traps for each piece of equipment in your plant send for the 36-page ARMSTRONG STEAM TRAP BOOK.

ARMSTRONG MACHINE WORKS
812 Maple St., Three Rivers, Mich.

ARMSTRONG *Inverted Bucket* STEAM TRAPS

Sold Under a "Satisfaction-or-Your-Money-Back" Guarantee.

The Greatest Story Never Told

An acquaintance of mine in the electric utility business was complaining the other day about "the Federal Government trying to take over the private power companies." It will be a serious blow to free enterprise if they succeed, he said, adding the usual phrases about losing glorious individual freedom, necessity for keeping sacred the policies laid down by our forefathers, etc., etc.

A serious situation indeed, but can it be possible that our utilities have been, to a considerable degree, responsible? Why haven't the men who manage utility companies gotten together to tell their story to the American public—a story unequalled in accomplishment and contribution to our economy. The record as *we* know it, but which the man in the street doesn't realize, runs about like this:

1. The electric utility industry has steadily brought down the cost of its product—the kilowatthour—through war and peace, inflation and deflation. Average for residential electricity was 7.38 cents per kilowatthour in 1922, 5.01¢ in 1935, 3.73¢ in 1941, 3.41 in 1944, and 3.09 in 1947. What else can you buy today at less cost than before the war?

2. The electric utility industry was one of the few able to meet every industrial demand during the war. This points to good organization, high technical skill, and steadfast service.

3. The electric utility industry is responsible for putting better lighting and labor-saving appliances in millions of American homes. Of course, the more power-consuming equipment placed in the home, the more power the utility sells, but private enterprise is engaged in creating business to *make* money—government is committed to *spending* it.

4. The electric utility industry has helped put more and more power at the disposal of the industrial worker—some 7.5 hp. per worker today. Besides making the worker's task easier and lighter, this has accounted largely for our ability to produce more goods and gain the highest and most envied standard of living in the world.

This record can be enlarged indefinitely, but why talk to ourselves? It's the other 145,000,000 Americans not in the power business who should know these facts—the greatest story never told to them.

If the public had an understanding of these things, there wouldn't be much fussing by Congressmen about nationalizing the utilities, because they vote for what their constituents want, or what they think the voters want. Right now, about all the consumer knows about his utility is that he gets a bill once a month. It is long overdue for the industry (and for every one of us too) to let him know how his electric power company is helping him enjoy a pleasanter, fuller, more secure life.

George Edwards

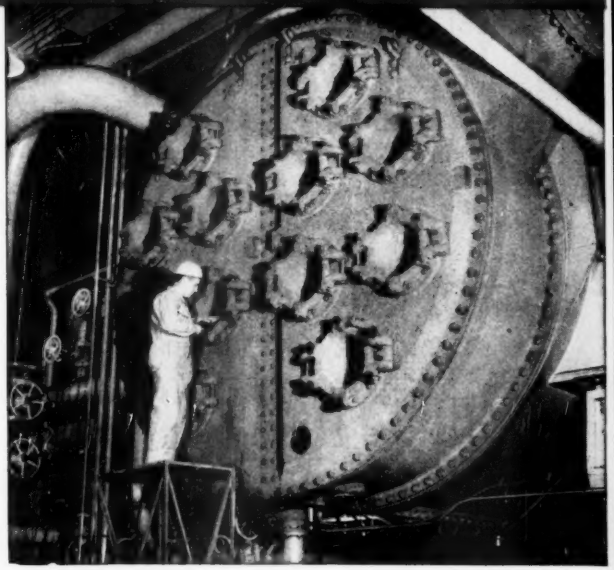
Engineer

DOWELL

SPECIALISTS IN SCALE AND SLUDGE REMOVAL WITH CHEMICALS

clean condensers rapidly—

the chemical way!



Engineers responsible for power plants in many industries know that *clean* condensers and boilers are important factors in *keeping down costs.*

To help you keep down costs and maintain designed operating efficiency in many types of heat exchange equipment, Dowell offers a fast, reliable chemical scale removal service which has been proved in thousands of successful cleaning jobs.

Dowell engineers fill the equipment with liquid solvents designed to dissolve and disintegrate the scale and sludge deposits which retard heat transfer. Dismantling is unnecessary; down time is reduced to a minimum.

Dowell engineers are experienced, know which solvents to use, and have the necessary equipment—special truck-mounted tanks, pumps, heaters and chemical proportioners—to make possible control of each stage of the job.

To clean condensers, boilers, many other types of heat-exchange equipment, water lines and water wells—call Dowell. Ask for literature and a prompt estimate on *your* job.

DOWELL INCORPORATED · TULSA 3, OKLAHOMA

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

CALL

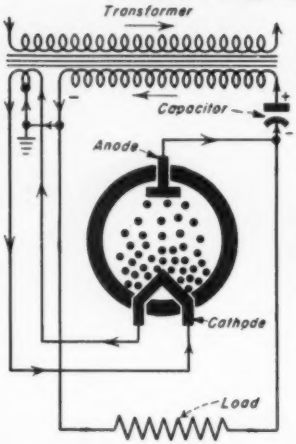
New York 20, Boston 16, Philadelphia 2, Baltimore 18, Wilmington 99, Richmond 19, Jacksonville, Atlanta, Buffalo 2, Cleveland 13, Pittsburgh 19, Detroit 2, Chicago 2, St. Louis 8, Indianapolis, Louisville, Kansas City 8, Wichita 2, Oklahoma City 2, Houston 2, New Orleans 12, Ft. Worth 2, Shreveport 23, Anniston, Alabama, Mt. Pleasant, Mich., Hamilton, Ohio, Charleston 27, W. Va., Salem, Illinois, Borger, Texas, Midland, Texas, Wichita Falls, Texas, Lafayette, La.

Long Beach, Oakland, Casper: Dowell Associate-International Cementers, Inc.

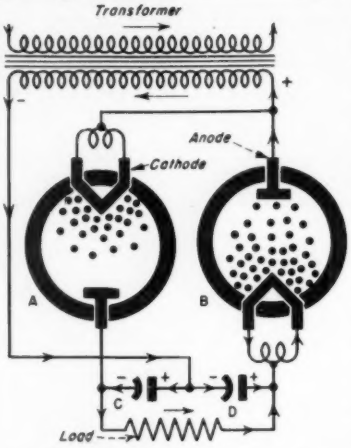
DOWELL

A SERVICE ORGANIZATION

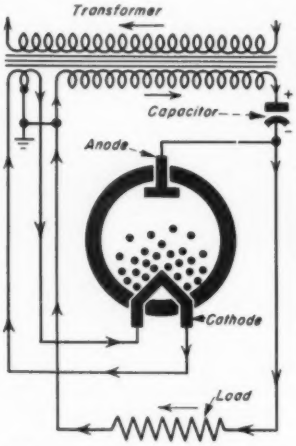
Diagrams of Voltage Doublers



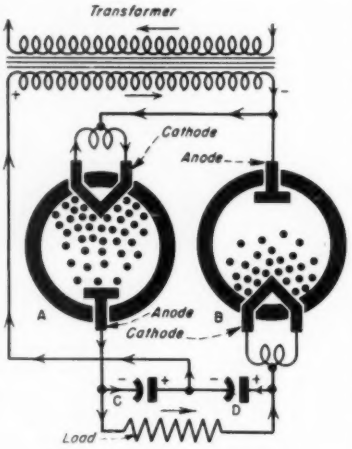
9 This voltage-doubler diagram uses one electron tube and one capacitor



11 Voltage-doubler circuit uses 2 electron tubes, 2 capacitors in series



10 Transformer, capacitor in series to apply a double voltage to the load



12 When transformer voltage reverses, tube A fires, charges capacitor C

hydraulic analogies can be applied to explain the action of capacitors and reactors in electric circuits. When you doubt their effects, set up the hydraulic equivalent of the circuit to assist you to a correct answer.

Filters, Voltage Regulators. Filters are used in several combinations of reactors and capacitors, as in Fig. 6*A* to *F*; Fig. 6*A* and *B* show filters we have already studied. Filter in Fig. 6*C* is similar to 6*B*, but has an additional reactor and capacitor to give a smoother dc than is obtained with the pi filter, Fig. 6*B*.

The three filters, Fig. 6*A* to *C*, have a capacitor on their input side and are known as capacitor-input filters or circuits. The three filters, Fig. 6*D* to *F*, have reactors on their input side and are called reactor-input filters.

Filters with a capacitor on their input side supply a higher dc voltage than a reactor-input filter. For, in the former, the input capacitor is charged nearly to the peak voltage of the rectifier. With a reactor on the input side the first capacitor is charged to the difference between the rectifier's peak voltage and the counter voltage induced in the reactor.

Filters with input capacitors have the disadvantage that the rectifier must pass a considerably higher peak current than the average dc supplied to the load. Therefore, the rectifier tube must be selected for this demand.

Because of the high current taken by the input capacitor, this type filter is generally used with vacuum-tube rectifiers only. When connected across the terminals of a gas-filled tube a capacitor acts almost like a short circuit because of the tube's low resistance. Filters for such rectifiers are usually the reactor-input type. The reactor limits the current that can flow to the capacitor, or capacitors, in the circuit.

A filter smooths out the voltage and current from a rectifier, but because of changes in load and their effects in the circuit, the voltage may vary widely. This can be compensated by a cold cathode or voltage-regulating tube connected across the output of the filter, as in Fig. 7. This tube holds constant voltage across its terminals even when the current varies from, say, 5 to 40 milliamp—0.005 to 0.04 amp.

This tube must always be connected in series with a comparatively high resistor, as shown, to absorb the difference between line volts and volts across the tube. In Fig. 7, this is the difference between 150 and 105 v, or 45 v, as shown. A 1500-ohm resistor will cause a 45-v drop when 0.030 amp flows through it and the tube.

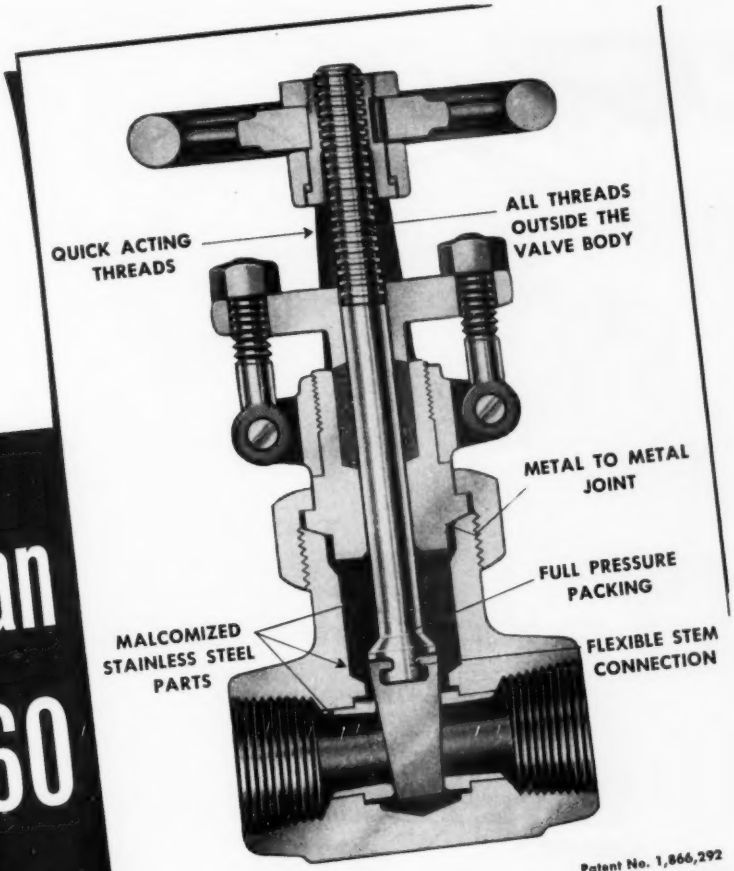
If we connect a 5250-ohm load resistor across the tube, Fig. 8, at 105 v, 20 milliamp flow through this resistor and resistor *R* in series. But 30 milliamp must flow through resistor *R* to hold the voltage across the tube at 105 v. Thus, 30 — 20 = 10 milliamp flow through the tube. What really happens is that the resistance of the tube increases with decreasing current and decreases with increasing current to hold constant voltage. Of course, the tube can only do this within the limits for which it is designed and in a circuit proportioned to the tube's requirements.

When electron-tube rectifiers supply high dc voltage and low current, as for testing, or for electrostatic precipitation, voltage doubling or multiplying circuits are used. In such circuits a relatively low-voltage high-current transformer supplies a high-voltage low current. Dc voltage may be several times peak value of the transformer's secondary. There are several of these circuits, but we will consider only two of the simpler ones to illustrate the principle.

Voltage-Doubler Diagrams. Fig. 9 is a voltage-doubler diagram, using one tube and one capacitor. When the transformer has the polarity shown, the tube conducts, as indicated, and charges the capacitor to the maximum

(*Continued on page* 160)

Chapman List 960



—the gate valve you can REPACK under FULL PRESSURE

This Chapman List 960 was specifically designed to simplify your maintenance problems. For instance, you can repack it without interrupting service . . . there's no pressure transmitted to the stem. And you can use it inside or out, for a forged steel packing gland protects vital yoke threads from rust and corrosion. To ensure longer wear, seats and plugs are made of superhardened stainless steel . . . body and yoke of tough forged steel.

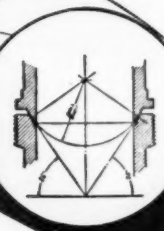
For your best buy . . . specify the Chapman List 960. Available in sizes from ¼" to 2" . . . carbon steel for pressures to 800 pounds; alloy steel for pressures to 1000 pounds at 750°F. For higher pressures, specify List 990.

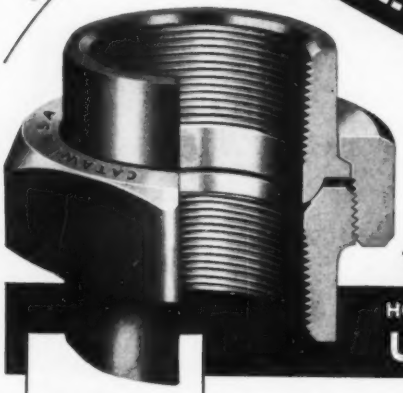
The Chapman Valve Mfg. Co.
INDIAN ORCHARD, MASSACHUSETTS

CATAWISSA

BALL-TO-ANGLE SEAT

gives you a PERFECT SEAL...





. . . even when the pipe is not perfectly aligned!

CATAWISSA

HOT FORGED STEEL UNIONS

Full ACME Threads or U. S. Standard V-Threads in Union nuts and on female end.

STANDARD AND DOUBLE EXTRA HEAVY

HOT FORGED from solid, rectangular steel bars, Catawissa Pipe Unions are free from sand and blow holes. The ball-to-angle seat design plus their ability to expand and contract with the pipe give you sure fire dependability . . . a perfect seal for every application!

CATAWISSA

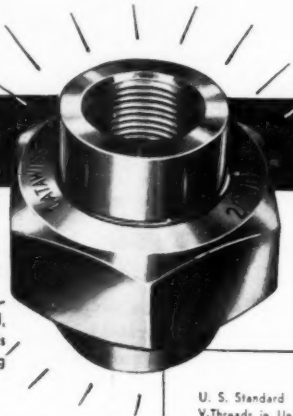
STAINLESS STEEL UNIONS

a type for every use!

MACHINED FROM SOLID STAINLESS STEEL BARS

Types 304, 316 and 347

Wherever caustic solutions are piped, Catawissa pipe union dependability is now available in corrosion-resisting Stainless Steel!



U. S. Standard V-Threads in Union nuts and on female end.

STANDARD AND DOUBLE EXTRA HEAVY

You specify the use and application. Catawissa will furnish a Stainless Steel Union recommended and guaranteed to give satisfaction! Standard and Double Extra Heavy types carried in stock. Specials made to order for socket welding, orifice plate, male-female or any other special use required!

IF IT'S A CATAWISSA . . . IT'S DEPENDABLE!

SEE YOUR INDUSTRIAL SUPPLY DISTRIBUTOR . . . or write direct for complete engineering data and your copy of BULLETIN 10-A.

CATAWISSA VALVE & FITTINGS CO.

206 Mill St. • CATAWISSA, PENNSYLVANIA

Electronics

(*Continued from page* 158)

of the voltage wave. During this period the tube and capacitor act practically as a short circuit across the load; consequently current flow through it is small. When the capacitor is charged it then blocks the load, and no current flows through it.

On the next alternation, Fig. 10, the transformer and capacitor are in series as indicated by the arrows, to apply double voltage across the load. During the next voltage wave the capacitor is charged as in Fig. 9, ready to assist the transformer in applying double voltage to the load during the following alternation.

This circuit has the same elements as a half-wave rectifier, Fig. 1, but in a different grouping. In Fig. 1 the tube is in series with the load and the capacitor in parallel, when in Fig. 9 and 10 the tube is in parallel with the load and the capacitor in series. This voltage-doubler circuit energizes the load on every other voltage wave only and is not satisfactory for many applications.

Where a load voltage and current of a higher and more uniform amplitude is required, two or more tubes and capacitors are used. Fig. 11 shows one of these circuits using two tubes and two capacitors. In this diagram the low-voltage sections of the transformer have been placed at the cathodes of the tubes. To simplify the explanation, in Fig. 11 assume capacitor *C* charged and the transformer polarity shown.

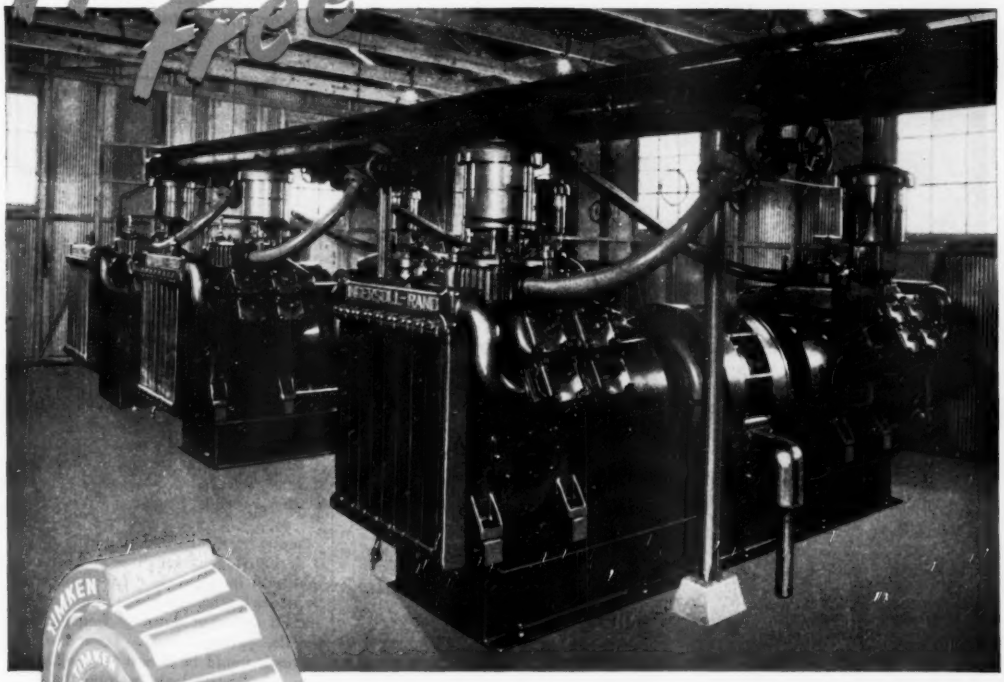
Tube *B* conducts as the arrows indicate and capacitor *D* is charged. Capacitor *C* has a polarity that adds its voltage to that of the transformer. This circuit is from the transformer's — terminal down through capacitor *C*, the load, tube *B*, back to the transformer. This applies the transformer and capacitor voltage to the load.

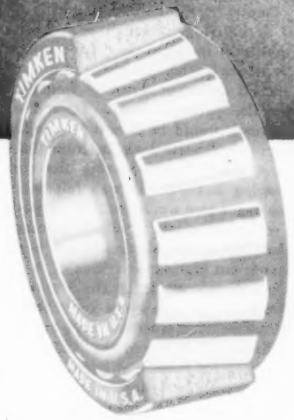
When the transformer's voltage reverses, as in Fig. 12, tube *A* conducts and through one circuit charges capacitor *C* as indicated. Another circuit is from the transformer — terminal, tube *A*, the load, capacitor *D*, back to the transformer. This again applies transformer plus capacitor voltage across the load.

The capacitors have the same polarity and are in series across the load. Therefore, they also act as a filter to maintain voltage across the load during the valleys between the dc waves. During these periods neither tube conducts and the circuit is from capacitor *C*, the load, and capacitor *D*.

Voltage doublers are used for very small power outputs because the capacitors would otherwise have to be

Friction-Free AIR-POWER PRODUCERS BY INGERSOLL-RAND





TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

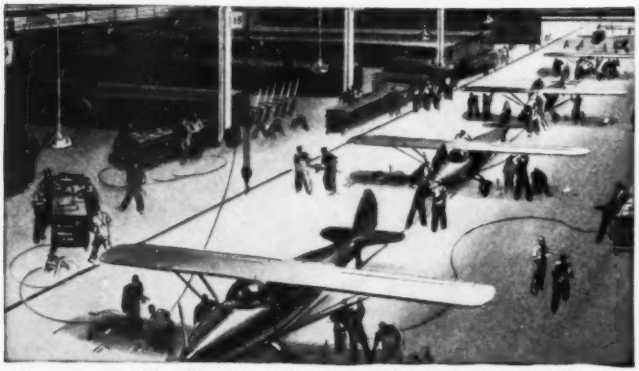
This battery of six, Ingersoll-Rand Type 40 air compressors equipped with Timken bearings played an important part on a large construction job. These sturdy air-cooled compressors are compact and light in weight, and are easily relocated from job to job.

Ingersoll-Rand knows that as far as anti-friction efficiency is concerned, a compressor is no better than its bearings. They know, too, that Timken tapered roller bearings assure anti-friction performance in full along with complete protection against radial, thrust and combined loads and misalignment of moving parts.

Make "Timken" your "buy-word" for anti-friction compressors and all kinds of construction equipment. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address "TIMROSCO".

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◫ AND THRUST →◫← LOADS OR ANY COMBINATION ✳

Seven new planes completed ...at a cost of $4.30!



New planes can't fly without control cable, and this manufacturer needed some —fast. He got it the same way he regularly gets many supplies and parts—by Air Express. Ordered in A.M., delivered to plant same day. 500 miles, 28 lbs., Air Express charge only $4.30. So production continued without a break.

$4.30 included pick-up and delivery at no extra charge—and receipt for shipment. All this, plus the *world's fastest shipping service*. That's Air Express—used with profit by every business.

Shipments go on all flights of Scheduled Airlines. Speeds up to 5 miles a minute—no waiting around. Direct service to over 1,000 airport cities, air-rail for 22,000 off-airline offices.

Facts on low Air Express rates:

22 lbs. of new fashions goes 700 miles for $4.73.
6-lb. carton of new jewelry line goes 1,000 miles for $2.24.
Same day delivery in both cases if you *ship early*.

Only Air Express gives you all these advantages: Special pick-up and delivery *at no extra cost. You get a receipt for every shipment* and delivery is proved by signature of consignee. One-carrier responsibility. Assured protection, too—valuation coverage up to $50 without extra charge. Practically no limitation on size or weight. For fast shipping action, phone Air Express Division, Railway Express Agency. And specify "Air Express delivery" on orders.

SPECIFY AIR EXPRESS
GETS THERE FIRST

Rates include special pick-up and delivery door to door in principal towns and cities

AIR EXPRESS, A SERVICE OF RAILWAY EXPRESS AGENCY AND THE
SCHEDULED AIRLINES OF THE U.S.

large and expensive. Relation between load and capacitors are usually such that the tubes conduct for a short period approaching the peak of each voltage wave. These circuits are used where a few milliamperes of dc are required at high voltage.

The next article will discuss battery-charging electronic rectifiers and thyratrons.

Old-Timer

(*Continued from page* 101)

vaged from Waterside, cools the oil using river water from the circulating-pump discharge. After the oil cooler, part of the oil passes through a fixed orifice to reduce pressure for the thrust bearing and then through a marine-type twin strainer having monel baskets with 3/16-in. perforations and No. 60 mesh monel screens. Balance of the oil flows to the hydraulic cylinder at full pressure and to the guide bearings for which individual throttling valves or "bafflers" and strainers are provided.

Oil returns to the reservoir, which has a removable monel screen of No. 14 mesh with 0.041 wire. Through this screen, oil passes before reaching the pump suction for recirculation.

A centrifuge, taken from another station, was installed as a precaution. It was anticipated that the unit would be started and shut down at frequent intervals, perhaps daily. During shutdowns it would be almost impossible to keep condensate leakage from the turbine gland from entering the thrust-bearing housing. It was felt that removing water would be a more positive precaution against oil contamination than any practical method for keeping water out during shutdowns. A shaft slinger ring, made at the station, deflects any possible water spray from the thrust bearing when the unit runs.

Experience showed that oil pressure to the thrust bearing is not critical. The manufacturer recommended not to exceed 10 psig, but variations between 10 and 25 psig produced no noticeable differences. During later test runs with pressure about 20 psig a stable shoe temperature of 120F was maintained and it was decided to leave the adjustments as they were.

A relay-operated backpressure controller in each pump-discharge connection maintains constant oil pressure. These valves bypass excess oil back to the reservoir to maintain 65-psig pressure. Some difficulty was experienced during the early operating stages in maintaining oil pressure to the hydraulic cylinder when the piston made a full stroke, as when coming on gov-

Controlled Quality Builds Added Endurance

Available in Carbon, Stainless and Alloy Steels

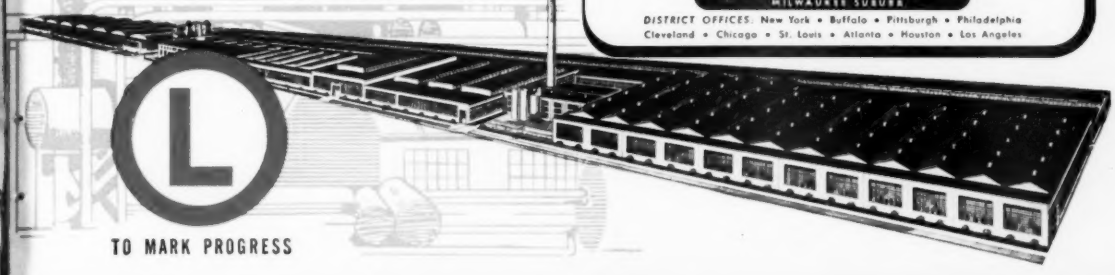
Ample strength and toughness are designed and forged into every Ladish fitting—providing a substantial margin of safety. Special emphasis on metallurgically sound materials and forging procedures . . . combined with advanced engineering . . . and rigid manufacturing controls assures users of Ladish fittings a uniformly high standard of dependability.

A COMPLETE LINE PRODUCED UNDER ONE ROOF
. . . ONE RESPONSIBILITY

LADISH CO.

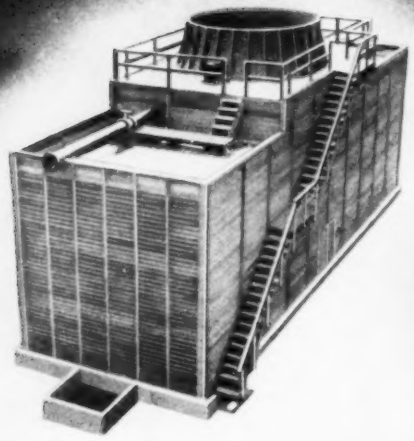
CUDAHY, WISCONSIN
MILWAUKEE SUBURB

DISTRICT OFFICES: New York • Buffalo • Pittsburgh • Philadelphia
Cleveland • Chicago • St. Louis • Atlanta • Houston • Los Angeles



TO MARK PROGRESS

Specify MARLEY Double-Flow



FOR SAFE OPERATION AND MAINTENANCE

STAIRWAY . . . DOUBLE-FLOW towers are equipped with a stairway built at the enclosed endwall of the tower. This eliminates fog envelopment and ice formation on stairways or ladders built over louvered sections. Operators do not have to climb high, dangerous ladders.

HANDRAILS . . . stairway and wide, level fan deck are guarded with high handrails. At no time is the operator at the mercy of high, gusty winds or in danger of inadvertently falling off the tower.

OUTSIDE WALKWAY . . . a short stairway leads to a walkway over each distribution basin. Water level may easily be adjusted or the basin cleaned. Complete flexibility of operation or maintenance is a result without the usual risks and dangers involved.

INSIDE WALKWAYS . . . through the interior of the tower, walkways enable the operator to observe water breakup, condition of structure, and operating conditions of the tower. This can all be checked while the tower is in operation without danger to the operator.

WALLED FAN CYLINDERS . . . each fan is enclosed with a fan cylinder . . . high enough for safety, low enough for easy inspection. And, there is plenty of room between the cylinder and fan deck railing for free movement without risk.

Tower owners and operators know that MARLEY DOUBLE-FLOW towers are SAFE TOWERS . . . safe in any stage of operation or maintenance . . . safe in any weather.

That's why more and more Safety Engineers of America's great industries are recommending MARLEY DOUBLE-FLOW COOLING TOWERS.

Ask for a MARLEY Factory-Trained APPLICATION ENGINEER to tell you more about the MARLEY DOUBLE FLOW Cooling Tower and its numerous SAFETY FEATURES. He'll be glad to help you solve YOUR water cooling problems. No cost or obligation.

MARLEY COOLING TOWERS

THE MARLEY COMPANY, INC. • KANSAS CITY 15, KANSAS

SANTOBRITE effective, low-cost SLIME AND ALGAE CONTROL

To eliminate sluggishness and obstructions caused by slime and algae in cooling systems, use Santobrite*— Monsanto's Sodium Pentachlorophenate, Technical. An inexpensive, effective algaecide, Santobrite is recommended for use wherever water is not used for drinking or bathing.

The Santobrite treatment requires no special equipment of any kind . . . Merely add to circulating water at any convenient location. Results are equally satisfactory whether used in large industrial installations or smaller systems.

To learn how Santobrite can help you maintain peak efficiency in cooling operations, send for a copy of Monsanto Technical Bulletin O-15. Address MONSANTO CHEMICAL COMPANY, Desk A, Organic Chemicals Division, 1763 South Second Street, St. Louis 4, Missouri.

SANTOSITE

controls oxygen corrosion in boiler systems

By removing all traces of residual oxygen, Santosite* (Monsanto's Sodium Sulfite, Technical) prevents oxygen corrosion in boiler tubes and other steam generating equipment. For complete information on this simple, economical control, send for a copy of Monsanto Technical Bulletin O-26. *Reg. U. S. Pat. Off.

MONSANTO
CHEMICALS — PLASTICS

MONSANTO CHEMICAL COMPANY
Organic Chemicals Division
Desk A, 1763 South Second Street, St. Louis 4, Missouri
Please send me ( ) Technical Bulletin O-15, on Santobrite; ( ) Technical Bulletin O-26 on Santosite.

Name_____ Title_____

Company_____

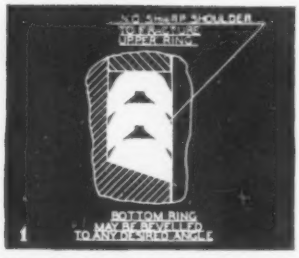
Address_____

City_____ State_____

SERVING INDUSTRY . . . WHICH SERVES MANKIND

CHESTERTON PARACHUTE PACKING

requires no gland pressure



These four figures show the complete operation of CHESTERTON Parachute Style "600" Automatic self-setting packing. Figure 1, above, illustrates the overlapping individual sealing function of each ring, the flat top and straight sides. Note how bottom ring can be shaped to individual stuffing box.

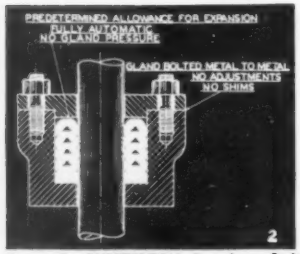
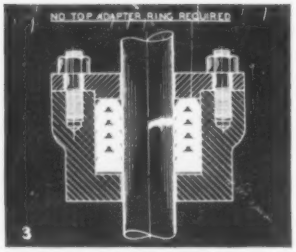


Figure 2, CHESTERTON Parachute Style "600" illustration shows proper clearance between gland follower and top ring. No gland pressure is required or desirable, as Parachute forms its own seal under pressure of medium packed.



In figure 3, CHESTERTON Parachute is illustrated under pressure. Packing has sealed automatically from pressure in force, and has moved to top of box where it is retained by gland lip.

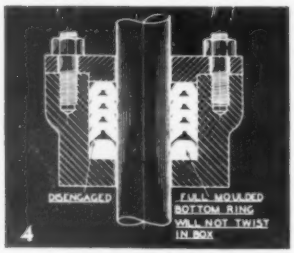


Figure 4 shows Parachute still under pressure; note that bottom non-sealing filler ring with pilot sides has dropped to bottom of box when pressure is equalized. It will not turn in box when ram is lowered.

Each Parachute ring seals individually, and due to unique design has individual lubricating channel between each ring, which assures longer wear by reducing friction. CHESTERTON Parachute will give you an entirely new packing concept. Order today, specifying 600W for water, 600S for steam, 600HO for hot oil, 600CO for cold oil, or write for descriptive literature with complete ordering information.

Parachute is one of 111 outstanding CHESTERTON styles

PACKING
Chesterton
SERVICE
A. W. CHESTERTON CO.

Established 1884

6 ASHLAND ST. EVERETT 49, MASS.

ernor or when the throttle tripped. Piston displacement was more rapid than response of the backpressure regulators.

This condition was not encountered in the original Waterside installation because a head tank with practically unlimited reserve supplied the oil. The difficulty was eliminated at Glenwood by installing a compression chamber of about the same size as the hydraulic cylinder adjacent to and parallel with it to the oil-supply line. This created sufficient oil reserve under line pressure to prevent a sudden drop in oil pressure during start of piston travel, and the backpressure regulators were then able to respond fast enough to maintain pressure.

Ac Calculations

(*Continued from page* 93)

all the steps in determining the amount of corrective kvar required. At 90% pf the kva would be kw ÷ pf = 100 ÷ .9 = 111. Kvar would then be $\sqrt{(111)^2 - (100)^2} = 48$.

Let us draw the power triangle for 90% pf superimposed on the triangle for 80% pf, Fig. 11. Amount of leading condenser capacity required to correct to 90% is evidently 75 — 48, or 27 kva.

If the cost of 27 kva of condensers is $270, it would take 3 1/3 years to return the investment cost by eliminating the pf charge.

That's all there is to pf correction. In summary, it means first construct the power triangle for your existing pf condition. Then compute and construct the triangle for the desired pf and superimpose both triangles. Subtract the kvar for the present pf triangle from the kvar of the desired pf triangle, and the difference is the corrective condenser capacity in kva required.

Generator Loading. It is important to remember that in the power triangle only power-rate quantities are used; kva, kw and kvar and not energy quantities, kilowatt-hours.

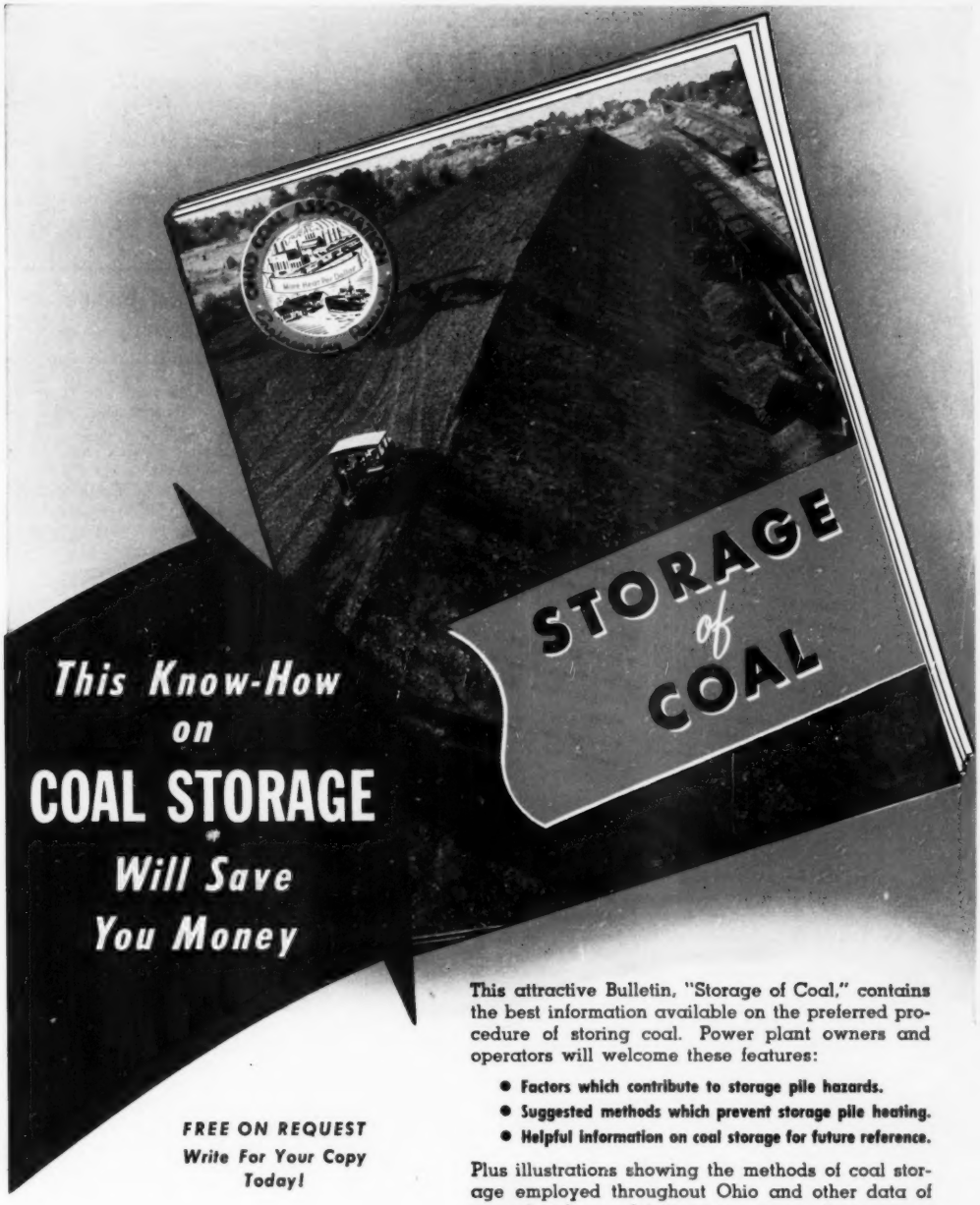
Another application of pf is in determination of generator loading. Let's assume a 1000-kw 6900-v 3-phase 60-cycle 0.8-pf diesel electric generator.

During the afternoon period the following readings are taken on the machine's meters: 790 kw, 300 kvar, and an ammeter reading of 70. The kva can be computed as follows:

$$\text{kva} = \sqrt{(790)^2 + (300)^2} = 840 \text{ kva};$$

$$\text{pf is} \frac{790}{840} \text{ or } 94\%.$$

Conclusion is that the diesel-driven gen-



This Know-How on

COAL STORAGE

Will Save You Money

FREE ON REQUEST
Write For Your Copy Today!

This attractive Bulletin, "Storage of Coal," contains the best information available on the preferred procedure of storing coal. Power plant owners and operators will welcome these features:

- **Factors which contribute to storage pile hazards.**
- **Suggested methods which prevent storage pile heating.**
- **Helpful information on coal storage for future reference.**

Plus illustrations showing the methods of coal storage employed throughout Ohio and other data of special value and interest to power plant owners and operators.

OHIO COAL ASSOCIATION

ROCKEFELLER BUILDING • CLEVELAND 13, OHIO

for small drainage jobs . . .

A NEW *SMALL* TRAP WITH *BIG* TRAP QUALITY FEATURES!

TEST
STRONG
OUTLET
INLET
DRAIN
• Renewable seat—easily removed for servicing.
• Strong's patented, wear-resistant Anum-Melt† valve and seat—guaranteed leak-proof for one year. Scientifically designed Hi-Cap* orifice gives greater capacity.
• Oversized ports—increased capacity.
• Horizontal inline connections—simplifies piping.
• Stainless 18-8 high ratio leverage.
• Large gasket area.
• Seamless, deep drawn, stainless 18-8 bucket—no welds.
• Bottom drain or inlet connection.

Available for pressures from 0 to 150 p.s.i., the Strong* No. 070 fits all standard trap applications. Built especially for use on laundry, restaurant and hospital equipment and in industry wherever small drainage is a problem.

As with all Strong Semi-Steel Traps, the 070 is guaranteed against defects in material and workmanship for one year. Write today *for more complete information.*

*T. M. Reg. U. S. Pat. Off.

STRONG, CARLISLE & HAMMOND COMPANY
1392 West 3rd Street
Cleveland 13, Ohio

† ANUM-MELT Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES

STRONG

erator is only partially loaded.

Percentage of loading can be just as easily determined. We know the full-load kva rating of the generator is 1000 ÷ .8, or 1250 kva. Percentage of loading is 840 ÷ 1250, or 67%.

By using the kva rating of the machine and the kva loading, the variable introduced by the pf does not affect determination of loading on the machine.

Dual-Fuel Engines

(*Continued from page* 125)

oil at 14¢, while with the same oil price and gas at 10¢ it goes to $54,000 per year per 1000 hp.

The dual-fuel engine is not only a highly efficient machine but it develops more power for a given size than can be had from a straight gas engine. The standard low-compression spark-ignition engine is never rated much in excess of 70 bmep. The nonsupercharged 4-cycle gas-diesel is today rated at from 80 to 85 bmep and the supercharged version of it at 120 to 125. The supercharged gas-diesel, even at this rating, is capable of much greater overloads than the spark-ignition engine, and thus we may safely say that we have increased the power of a given engine size by about 75%. This unit requires, therefore, no more building space and foundation than its lowly rated competitor.

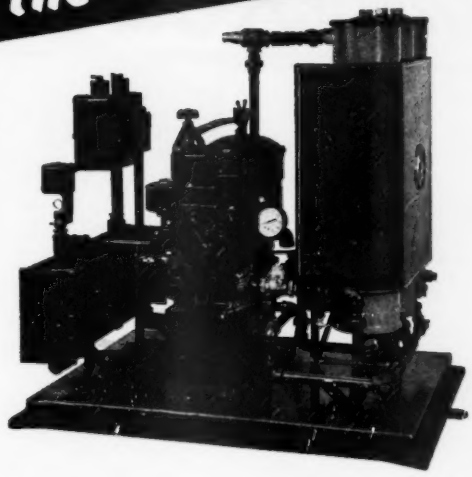
Cooling System. Another point of importance is that its cooling system is no larger. One cannot develop high thermal efficiency without drastically reducing the amount of heat going into the water jackets. In general, the cooling equipment that took care of the 70-bmep engine will now nicely serve the new engine with its 75% increased rating. The economics of the dual-fuel engine are therefore about as interesting from the installation-cost angle as from the fuel-consumption angle.

On the whole, it may be said that the dual-fuel engine may be properly applied any place gas is available. Nor does the gas supply need to be constant and certain. In fact, this very feature enables use of the dual-fuel engine to obtain a better gas rate, as the contract may be arranged for cutoff should the gas company find it convenient because of weather conditions or other factors.

The dual-fuel engine has been widely applied to municipal and industrial plants and to a lesser degree in sewage plants and on oil-field drilling rigs. A large percentage of our diesel production today is on the dual-fuel arrangement. In less than four years since

DIRT · WATER · CARBON

All removed by the "PURI-FILTER"



THE DE LAVAL "Puri-Filter" removes all three major contaminants of Diesel lubricating oil: dirt, water and colloidal carbon. The first two are separated from the oil by centrifugal force in the bowl of the De Laval Oil Purifier—the water being discharged continuously. The colloidal carbon is filtered out of the purified oil by the filters.

The De Laval "Puri-Filter" combines the De Laval "Uni-Matic" Oil Purifier and Fram "Filcron" Filters. Because the combination unit gets rid of all contaminants down to one micron in size, and likewise keeps the oil completely free of moisture, it is the most effective means ever devised for protecting Diesel engine bearings.

Crank cases remain clean when Diesel oil is "Puri-Filtered." Write for Bulletin DL-1, which gives additional details.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL *Oil Purifiers*

FOR DIESEL LUBRICATING OIL

WHY DART UNIONS

Pay Off in

LONGER SERVICE

INSPECT THIS JOINT
It's spherical — the two seats form true bearing surfaces, making a drop-tight ball joint.
1.
NOTE THE METAL
It's bronze — both seats are non-corroding and extra-wide.
2.
CHECK THE RUGGED BODY
It's extra strong — with shoulders that withstand wrench abuse . . . high-test, air-refined malleable iron body and nut which are practically indestructible.
3.
DARTS
always mean longer service at lower cost. Their features speak for themselves.
4.
DART

DART UNIONS

E. M. DART MANUFACTURING CO.
PROVIDENCE 5, RHODE ISLAND

their inception, a number of American builders have applied large numbers of these engines so their practicability has been thoroughly proved. It can be safely predicted that a fair percentage of diesel production in America in years to come will be in the dual-fuel form.

Technical Briefs

(*Continued from page* 152)

combining functions of both a check and gate valve. The slower the closing rate, the less the resulting pressure rise. Loss of water and reverse rotation of pumps is seldom objectionable.

3. Use special check valves, such as balanced and loaded, or provide a bypass around a check valve that can be closed slowly, manually or automatically after the check valve is closed.

4. Use air chambers, accumulators or surge tanks. The latter are the most expensive and hardly ever justified under ordinary circumstances. The U. S. Government built one installation of this type at Granby, Colo.

5. Relief valves are widely used to protect various hydraulic equipment. When provided with a positive control, these are known as surge suppressers.

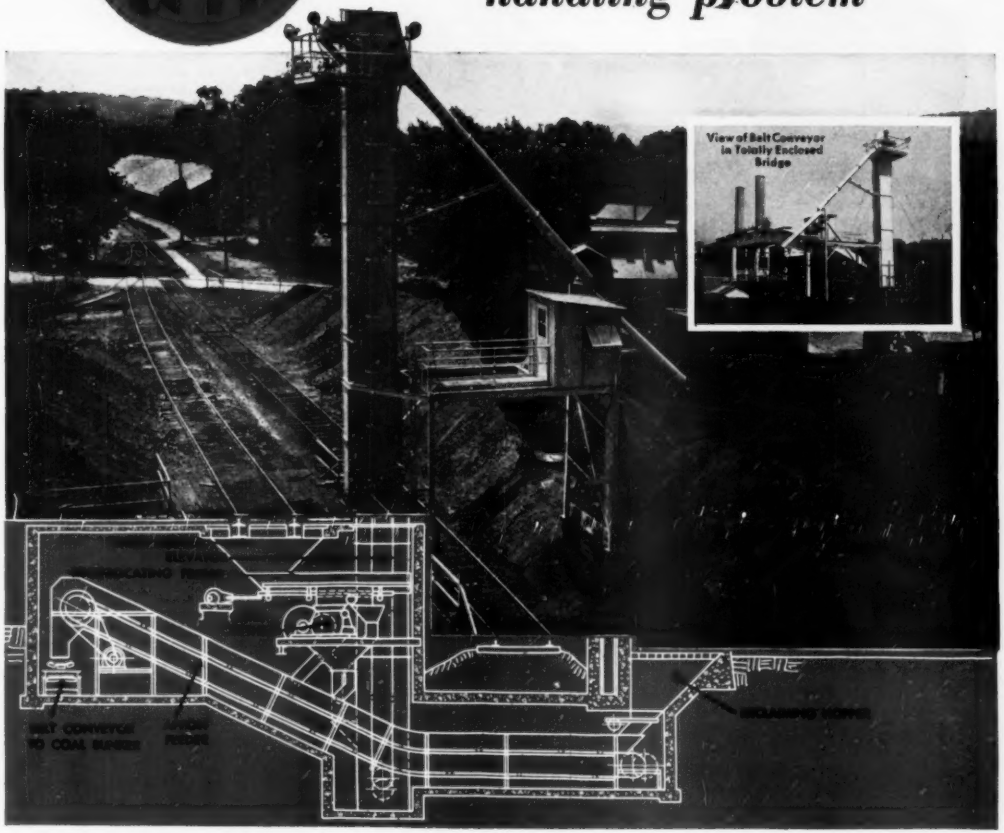
6. When water-column parting is unavoidable in a pipeline, vacuum breakers are installed to admit air that cushions the shock when the two parts of the water column join together.

According to the author, the graphical solutions of water-hammer problems are just as accurate as the analytical solutions. There are numerous experimental proofs of the soundness of the basic water-hammer theory. The irregular shapes of the pressure-rise curves, plotted from theoretical calculations, were reproduced with surprising exactness by accurate recording instruments. The accuracy of solutions depends on the accuracy of the information about rate of flow during valve-closure time.

In centrifugal-pump applications it is not often that flow rate for different valve positions is known. A motorized gate valve with a uniform stem travel does most of the throttling in the last quarter of closure. The follower-ring valve produces a more uniform retardation of flow. With special follower-ring valves, any desired rate of flow retardation, including uniform, can be obtained, but their use is limited. Thus, for an accurate solution of water-hammer problems it is necessary to (1) visualize the sequence of events clearly (2) establish the end condition accurately, including rate of pipe-flow retardation. *ASME Paper No. 48-A-89.*

(*Continued on page* 172)

went *Underground* to *Overcome* this handling problem



More steam power for peak production at the Picatinny Arsenal, Dover, N. J., called for more coal—more in reserve, more flexible equipment for handling it.

Problem was how best to augment existing facilities to meet this greater demand. A Gifford-Wood engineer looked over the ground—recommended the versatile handling system shown. It provides tremendous reserve storage in addition to bunker storage.

Note how new G-W system can take coal directly from track hopper—(1) through crusher to apron feeder, then by belt conveyor to boiler house bunker, or—(2) by bucket elevator and swivel chute to ground storage. Coal is reclaimed by drag scraper from ground storage and conveyed to bunker by use of the *same* system.

But this is only one of scores of instances where G-W took over the complete job—design, construction and erection . . . shouldered all responsibility. For G-W materials handling experience dates back 140 years . . . definite assurance that consultation with a Gifford-Wood engineer can help *you* solve *your* coal handling problems.

G-W HANDLES IT . . .
faster • easier • cheaper
SINCE 1814

GIFFORD-WOOD CO. ⊛ 5220

NEW YORK 17
420 LEXINGTON AVENUE

Factory:
Hudson, N. Y.

CHICAGO 6
565 W. WASHINGTON ST.

New GOULDS Centrifugal Pumps

CLEAR LIQUIDS AT LOW COST

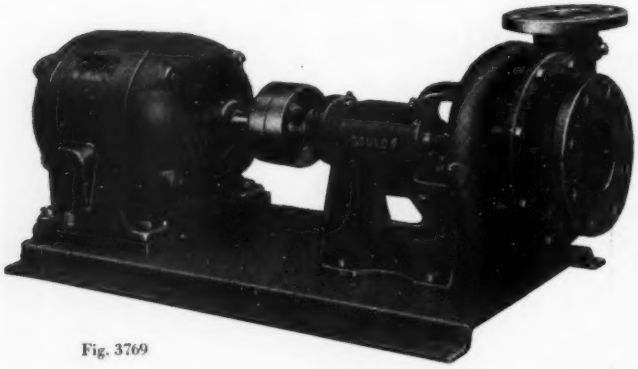


Fig. 3769

APPLICATIONS: Ideal for clear liquids, general water supply, circulating, transfer service, air conditioning, irrigation, and similar uses.

ADVANTAGES: Advanced design gives you compact simple construction with high operating efficiency, ease of installation and maintenance, and unusually low prices considering ratings and quality.

SIZES: Available in 14 sizes for both motor and belt drives. Capacities from 10 to 1800 GPM with heads to 120 ft. Available in standard fitted and all iron construction.

Write for Bulletin 622-A-2 today for complete details on this new centrifugal for clear liquids.

GOULDS

The Right Pump For Your Job

PUMPS, INC.

Dept. PO, SENECA FALLS, N. Y.

Please send your FREE bulletin 622-A-2 to:

YOUR NAME_____

COMPANY_____

STREET_____

CITY_____ STATE_____

PREDICTING LIQUID JET PUMP PERFORMANCE, *by R G Folsom, University of California.* Basic principles of the jet pump are introduced, while explaining the importance of momentum considerations in calculating over-all performance of a given unit. Although momentum considerations give little or no information regarding the design details, certain recent experimental investigations clarify some geometrical relationships for optimum performance. Results from the application of the principles are stated and confirming experimental conclusions given. Graphs present over-all performance of a single unit with a given liquid over any external-pressure conditions.

The usual water-pressure system, consisting of an inner-connected centrifugal and jet pump, is investigated. Calculations are made to demonstrate the shift in performance to be expected when pipe diameters and lengths are changed and the characteristics of the centrifugal pump are varied. Included are additional sample problems, which illustrate the methods of using information from the basic experimental curves to calculate or predict the operation of the jet pump in any type of installation. *NCIH Paper.*

Horsepower

(*Continued from page* 107)

trated forces of electromagnetism could be made to whirl this torque at 60 rps to produce the power of a thousand horses. And how amazed he would be that this could be done in a package so modest as to be dwarfed in size by a horse!

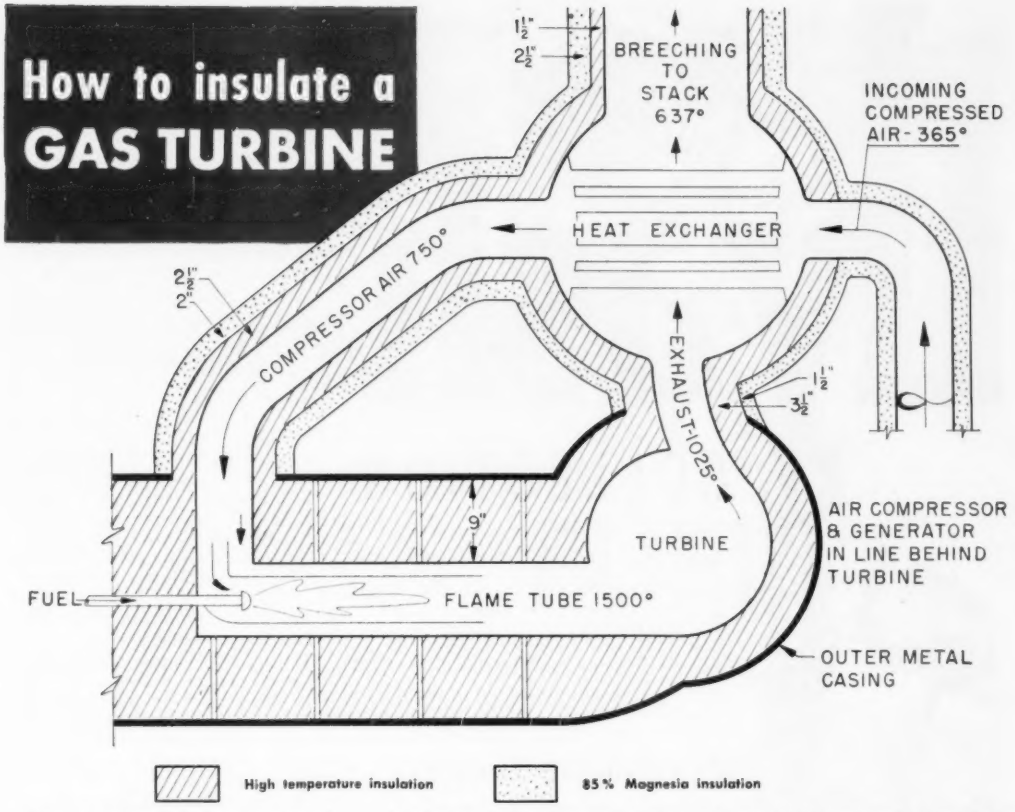
Electric motors, except in tiny sizes, are all primarily rated for mechanical output by "horsepower." Today's motor horsepower standards provide a wide range of ratings in logically increasing intervals of size to meet any need. Thus Watt's terminology lives on, both for rating electric motors and for practically all other mechanical-power-producing apparatus. We still call it "horsepower," a continuing tribute to Watt's pioneering and to the animal, skillfully adapted by evolution, that first enlarged man's power.

Oxygen-free Feedwater

(*Continued from page* 89)

Summary. Ultimate decision on the most advantageous method of removing oxygen is a matter of individual judgment. The cycle using a deaerating

How to insulate a GAS TURBINE



This is a schematic cross-section of an experimental gas turbine. Temperatures throughout this piece of equipment range from a high of 1500° F., in the flame tube to a low of 365° F., in the incoming compressed air piping.

This wide variation of temperatures calls for careful specification of the insulation so that maximum operating efficiency will be maintained throughout the turbine.

Around the flame tube a thickness of 9" of high-temperature block is specified. This is sectionalized into four-foot lengths, divided by metal fins to hold it in place as the flame tube expands and contracts. The insulation on the flame tube and turbine is encased in a metal shell.

Insulation on the compressed air piping, which operates at 750° F., is 2½" of high-temperature block and 2" of 85% Magnesia. The breeching to the stack is covered with 1½" of high-temperature block and 2½" of 85% Magnesia, the recommended thickness for the 637° F. operating temperature. The exhaust passage from the turbine to the heat exchanger reaches a temperature of 1025° F. and is insulated with 3½" of high-temperature insulation and 1½" of 85% Magnesia. Finish on all the exposed insulation is two coats of hard finish asbestos cement.

Helping you arrive at the proper insulation specifications for new and unusual equipment or applications is an important part of the work of Armstrong's Insulation Contract Service. In addition to competent engineering advice, this complete service can furnish you with top-quality materials and experienced mechanics to apply them. The next time you need insulation to save fuel or to make a process or piece of equipment work more efficiently, call the Armstrong Office nearest you.

FREE INSULATION CHART

This chart lists types and thicknesses of insulation for temperatures from 300° below zero to 2800° F. Write for your copy to Armstrong Cork Company, Industrial Insulation Dept., 7003 Maple Ave., Lancaster, Pennsylvania.

ARMSTRONG'S INDUSTRIAL INSULATION

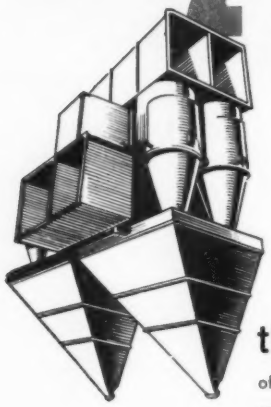
Complete Contract Service For All Temperatures

From 300° Below Zero

To 2800° Fahrenheit

Custom Tailored

fly-ash COLLECTION



the agonizing trickle

of maintenance costs won't add up to a costly dollar-pool, if your fly-ash collection system is custom-engineered by Buell. The large-diameter cyclones won't interrupt your operation by clogging. Individual inlets to each cyclone insure even distribution of dust-laden gas. The utter simplicity of a Buell cyclone prevents costly operating complications. With all this, the patented van Tongeren 'shave-off' makes operating efficiency surprisingly high. The money-saving facts are all in the new 32-page catalog. Write: Buell Engineering Co., 10 Cedar Street, New York 5, N. Y.

buell

Engineered Efficiency in
DUST COLLECTION

heater shows slightly better heat economy because (1) the condensate can be heated to full saturation temperature instead of within the 5-F terminal difference found in most closed heaters and (2) the bleed condensate does not all cascade back to the condenser.

The closed-heater cycle is probably simpler to operate, but with the deaerating heater chances of contaminating boiler water are less likely. Each system has flashing complications that must be guarded against. Condenser deaeration may call for injection of additional chemicals into the feedwater.

Power-Plant Problems

(*Continued from page* 136)

ing switch No. 2; read current I_2.

5. Repeat connection for each phase.

If both ct have same ratio, I_1 and I_2 will, or should, be equal. Low value of I_1 can be spotted immediately, indicating a shorted secondary. But, if ct turn-ratio is not known, take the ratio of $I_1 \div I_2$ for each phase. Since all three ratios should be the same, a low ratio will indicate shorted secondary.

Primary circuit must be interrupted by some other means than the disconnect during test. Best plan is use of two single-pole breakers other than the jumpers across ocb. Close shorting switches before selector switch is opened.

DAVID H NOBLE *Lexington, Ky.*

Check Current Balance

ASSUMING *CA* has balanced feeder load the best way to check ct secondaries is to insert a 5-amp ammeter in each leg of secondary circuit. Simultaneous readings should be the same if windings are OK. Volt-amp capacity of most ct is so low that shorted turns show up immediately.

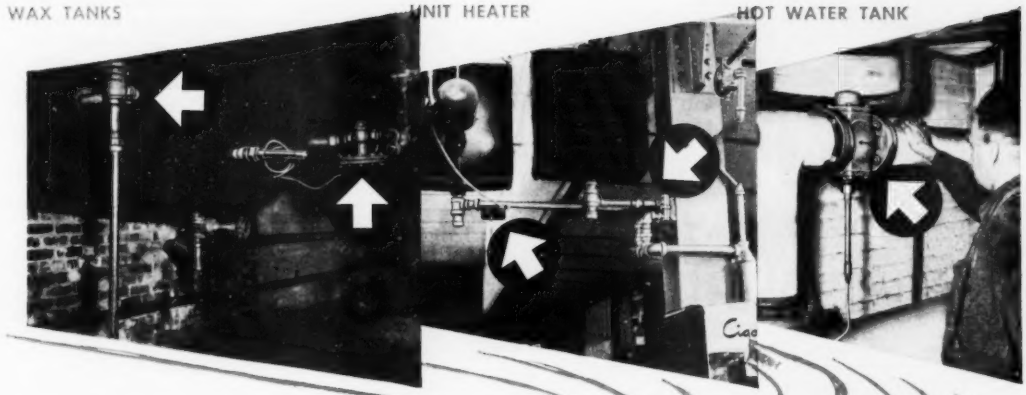
Switches may be used putting the same meter alternatively into the three circuits. Ct secondary should be short circuited before disconnecting any wires.

Ordinarily, ct are rugged in design and should not have short circuited secondary turns unless they have been operated with secondary open circuits.

G R ELDER *Cleveland, Ohio*

Split-Core Ammeter OK

BECAUSE OF LOW VOLTAGE between turns in a ct secondary, the probability of having shorted turns under proper use is remote. Open circuiting of the secondary while primary current is flowing could result in break-down between secondary turns. We have some old "crocks" that have seen nearly 40 years



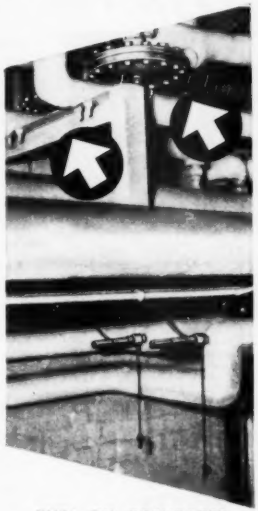
HOW SARCO SAVES FUEL

"I've been paying for Sarco Steam Traps and temperature controls for years in wasted heat. Thought I might as well have them and the other advantages too."

This statement was made by executives who knew the facts, but just "never got around to it."

Take the wax tanks illustrated. Tons of hot wax are stored, and poured into 100 lb. paper bags for shipment. Too cold—it won't run. Too hot, it burns or ruins the bags and wastes heat. The Sarco No. 9 Steam Trap at the left extracts all usable heat in the steam coils before it lets the condensate go. The Sarco Control at the right, holds the temperatures within a degree—and again, saves steam.

Unit Heaters start and stop at the command of Sarco Electric Controls. Hot water is held at correct temperatures in converters and tanks, or blended for wash water. Even fuel oil preheat is exact when an All-Sarco job is installed. These savings and many more are available through the Sarco Representative near you. Ask for Catalogs applying to your special conditions.



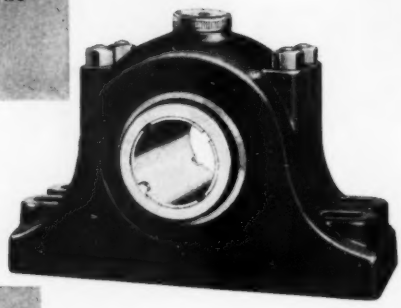
FUEL OIL PREHEATER

SARCO
SAVES STEAM

SARCO COMPANY, INC.
Represented in Principal Cities
Empire State Building, New York 1, N. Y.
SARCO CANADA, LTD., TORONTO 5, ONTARIO

232

Quality-proved by use on millions of industry's toughest jobs



Mounted, sealed, housed, fully assembled, ready to lock on the shaft

Delivered from stock in 4 basic types and a vast range of sizes

"DODGE-TIMKEN" MEANS QUALITY!

100-TON PULL

Three Dodge-Timken Pillow Blocks carry the load of a 100-ton pull of castings in and out of a shot blast chamber for the Falk Corporation, at Milwaukee. The bearings save the gear reducer from side pull and allow the shaft to turn easily even while taking the full load. Perfect operation for 8 years to date.

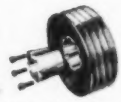
It was Dodge who took the famous Timken Bearing, mounted it, sealed it, housed it and delivered a pillow block of new high quality—fully assembled, ready to lock on the shaft and carry the power loads of industry with new efficiency.

Power savings, improved machine operation, reduced maintenance, elimination of spoilage and steadier production—all result so regularly from the application of Dodge-Timken Bearings that this great line is widely accepted as the standard for comparison in up-to-date power transmission layouts.

Ask the Transmissioneer, your local Dodge Distributor, how these bearings and other Dodge "firsts" can help you achieve better, more economical production.

DODGE MANUFACTURING CORPORATION, MISHAWAKA, IND.

OTHER DODGE "FIRSTS"



TAPER-LOCK V-BELT SHEAVES. Easy on—easy off—hold fast to shaft.

ROLLING GRIP CLUTCH. No toggles! Flexibility. Positive drive.

"SC" BALL BEARING Pillow Block with new Neoprene metallic-backed seal.

DODGE of Mishawaka, Ind.

CALL THE TRANSMISSIONEER. Look for the name of the Transmissioneer, your local Dodge distributor, under "Power Transmission Equipment" in your classified telephone directory.

FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY, ETCHING COMPANY OF AMERICA, 1320 MONTANA STREET, CHICAGO 14, ILLINOIS

service and are still batting 1000.

We use a split-core ammeter to compare readings with an ammeter in series with the relays. This is fairly reliable as a check on transformers and wiring to relays. If there are two sets of transformers, one set for relaying and one for metering, ammeters in both secondaries will be a good check. Use rubber gloves with the split-core ammeter.

As relays are usually set to trip at relatively high currents, the loss of a few secondary turns should not seriously impair operation in event of a short-circuit on feeder.

J A COULDEN *Hamilton, Ontario*

Try Low Primary Voltage

EXACT WAY to check ct is by measuring current ratio. We get good results by disconnecting the ct from line and applying low voltage to primary. Primary and secondary current is measured with secondary shorted. Shorted secondary turns make current ratio differ appreciably. If transformer is OK, current ratio will be approximately the inverse of ct turn-ratio.

CARLOS PENIZA
Ensenada, Puerto Rico

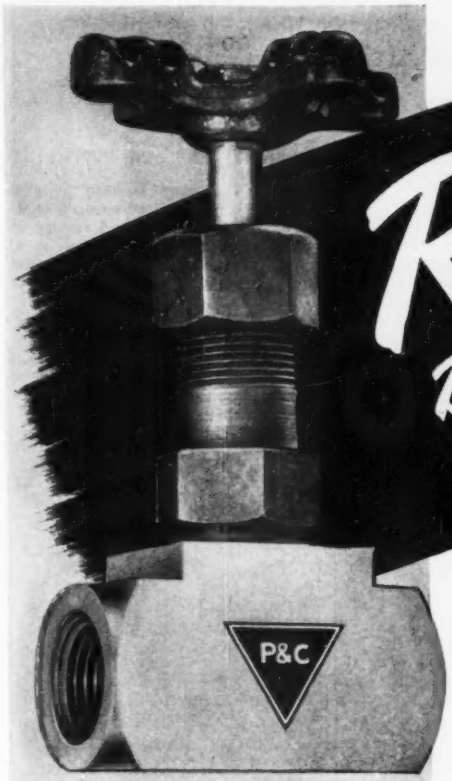
Determine Current Ratio

SIMPLE AND EFFECTIVE TEST for shorted ct secondaries is to compare secondary and primary current. Run secondary ammeter circuits through permanent make-before-break switches. Make-before-break switches must be installed in secondary circuit to prevent accidental opening of secondary during time current is flowing in primary.

While testing for shorted windings it is well to check secondary ground connection. Where a number of different size ct are used in a plant, a small card with current ratios for each type is handy.

TYLER G HICKS *New York, N. Y.*

The standing committee in charge of reviewing *Simplified Practice Recommendation R207-45, Pipes, Ducts, and Fittings for Warm-Air Heating and Air Conditioning*, has approved a revision of this recommendation and copies have been mailed to producers, distributors and users for acceptance or comment, according to an announcement by the Commodity Standards Div of National Bureau of Standards. The recommendation that was originally issued in 1945 established a stock list of pipes, ducts and fittings for both gravity and forced-air-heating and air-conditioning systems. The proposed revision adds sketches and dimensions for four types of take-off fittings for extended plenum systems. Mimeographed copies of the proposed revision may be obtained from *Commodity Standards Div, National Bureau of Standards, Washington 25, D. C.*

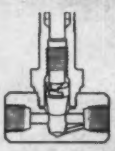


R-P&C BAR STOCK VALVES

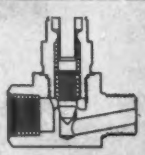
RUGGED
ECONOMICAL
DEPENDABLE
VERSATILE

Following is a tabulation of working pressures of these valves:

MATERIAL	FIGURE NO. Globe	Angle	WORKING PRESSURE
BRONZE	1030	1031	500 lbs. at 150°F
CARBON STEEL	1040A	1041A	4000 lbs. at 150°F 600 lbs. at 750°F 550 lbs. at 900°F 475 lbs. at 1000°F
12-14 CHROME STAINLESS STEEL	1050	1051	4000 lbs. at 150°F
COMBINATION 12-14 CHROME STAINLESS STEEL CARBON STEEL	1060	1061	4000 lbs. at 150°F 600 lbs. at 750°F 550 lbs. at 900°F 475 lbs. at 1000°F
18-8 STAIN. STEEL (TYPE 316)	1070A	1071A	4000 lbs. at 150°F
THRU PORT VALVES 1045A			1000 lbs. at 150°F 600 lbs. at 750°F 550 lbs. at 900°F 475 lbs. at 1000°F

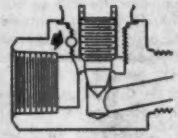


THRU-PORT—for handling heavy liquids which carry suspended solids or where precipitates or deposits cause trouble.

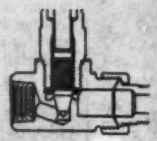


MALE and FEMALE END—Available in both Globe and Angle valves—useful for many special hook-ups.

(SOCKET WELDING ENDS NOT ILLUSTRATED)



LOCK BONNET—for lines carrying hazardous liquids or where there is extreme vibration.



UNION END—where frequent disassembly is required or to use instead of a break elsewhere in the line.

For more complete information, get in touch with your Reading-Pratt & Cady distributor or the District Office nearest you. Or, if you prefer, write direct to the factory at Reading, Pa.

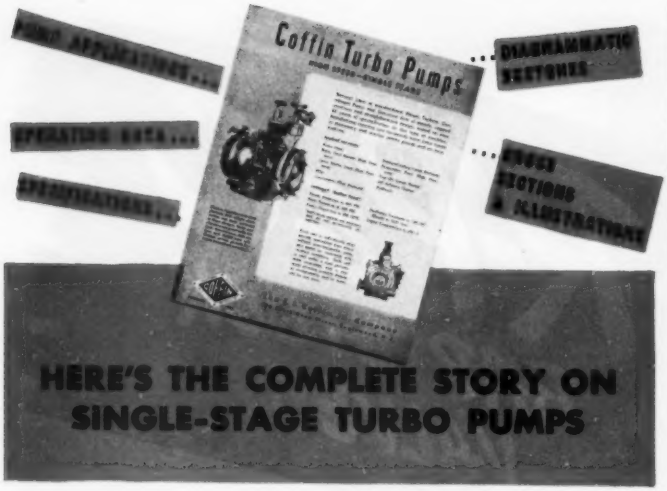
ACCO

Reading, Pa. • Atlanta • Baltimore • Boston • Chicago • Denver • Detroit
Houston • New York • Philadelphia • Pittsburgh • San Francisco • Bridgeport, Conn.

READING-PRATT & CADY DIVISION
AMERICAN CHAIN & CABLE

TRADE MARK

READING-PRATT & CADY VALVES



The Only Single-Stage Turbo Pump that's **Power-Packed** for **Performance**

3- TO 12-STAGE PERFORMANCE FROM A ONE- OR TWO-STAGE PUMP — because Coffin design gives you extremely high efficiency, plus high-speed, two-bucket row turbine operation, you get minimized steam consumption, even at 7200 rpm, and 3- to 12-stage (3600 rpm) pump performance from any Coffin one- or two-stage pump. **No other pump can offer you more performance, dependability or superlative engineering than Coffin Pumps.**

LONG, SERVICE-FREE OPERATION — Coffin Pumps are so finely designed, engineered and ruggedly built that 10,000 hour continuous service periods between inspections are not unusual. Compact and practically noiseless and vibrationless, Coffin Pumps blend with any difficult pumping assignment you may have within their rated specifications.

Representatives in principal cities

FREE! A complete 4-page illustrated bulletin on **COFFIN TURBO PUMPS** with all operating data, applications, specifications that you may require for your next job. Write for Bulletin "S" today.

See ASME Catalog Sweet's Handbook and Thomas Register

INDUSTRIAL • RAILROAD
COFFIN

The J. S. COFFIN JR., COMPANY
326 SOUTH DEAN STREET ENGLEWOOD, NEW JERSEY

AVAILABLE WITHOUT OBLIGATION—SPECIFIC PROPOSALS ON RECEIPT OF OPERATING DATA.

Gentlemen: Please send me a copy of Bulletin "S" by return mail.

NAME.....TITLE.....

COMPANY.....

ADDRESS.....CITY & STATE.....

154

New Equipment

(*Continued from page* 148)

Continuous Blowdown E108

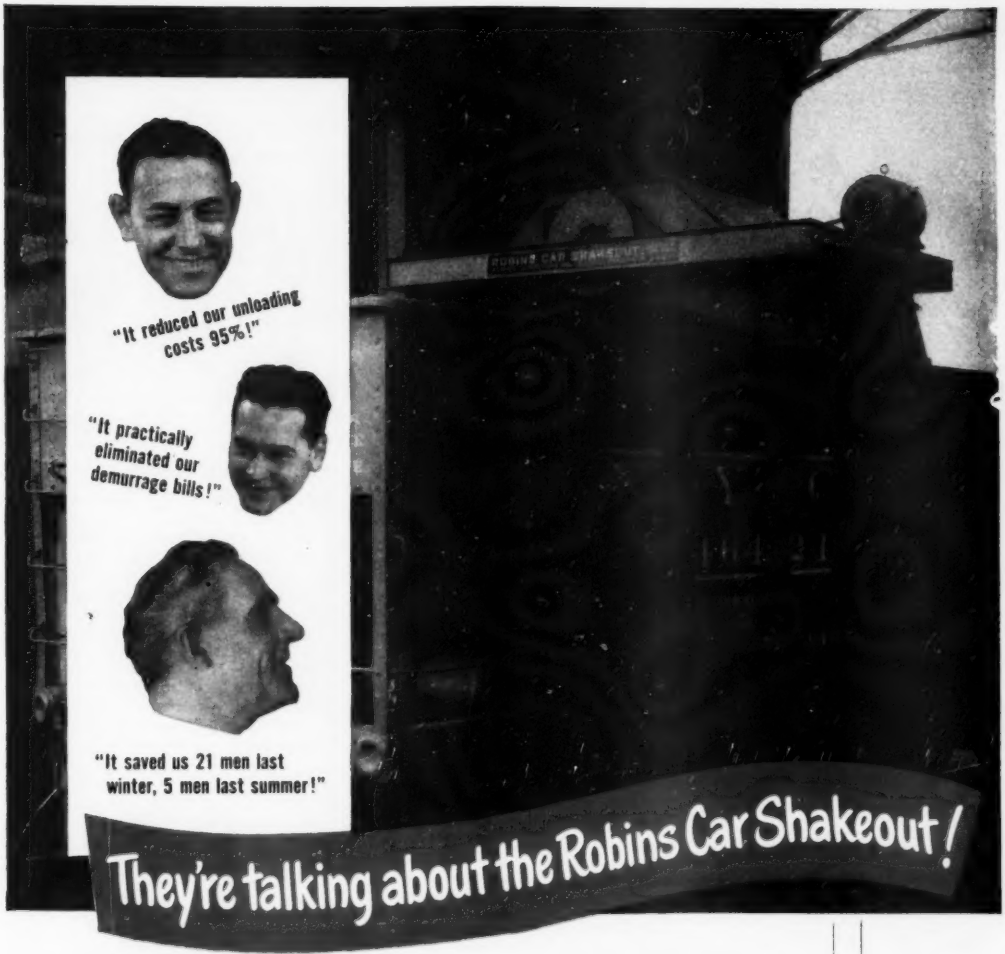
A FLOAT, constructed expressly to meet conditions of pressure and temperature in the boiler, keeps the draw-off opening at proper height to skim surface and draw off suspended and dissolved solids. Float is moored by a hinged metal tube connected to a nipple through boiler shell. Dirt-laden water passes through a filtering screen before entering control valve or orifice. A connection with cooling coil provides for taking samples of boiler water for testing. **Elvy Co, South Bend, Ind.**

Defrostproof Hydrant E103

DE-ICER HYDRANT eliminates need for underground pits, gravel boxes, drainage lines, sump pumps, special insulation and electric heating coils. No water is drained off below ground. Key to the design is a rubber tube inside riser spout. With water pressure turned on, rubber tube expands against inside of riser spout, allowing a full column of water to flow. As soon as water pressure is turned off, the rubber tubing, which is installed under tension, contracts to an internal diameter not much greater than a lead pencil.

In cold weather the thin column of water inside the tube freezes down to frost line. Whenever the valve is opened water pressure again expands the tubing and water flows up and around the pencil of ice. The ice breaks and flushes out with the water, giving a free-flowing stream almost instantly.

Valve has a composition disk and is operated by a lever at top of hydrant, the lever having a cam at its lower end which thrusts valve stem downward when lever is moved forward. Spring action combined with water pressure returns valve disk to its seat. Hydrant is completely sanitary, having no underground drainage holes


"It reduced our unloading costs 95%!"
"It practically eliminated our demurrage bills!"
"It saved us 21 men last winter, 5 men last summer!"
They're talking about the Robins Car Shakeout!

And who isn't? Men who have used the Robins Car Shakeout to unload their hopper cars are actually amazed at how it saves them time, money and manpower.

And no wonder! Time was when it used to take several man-hours to empty a 70-ton hopper car with a crew of 4 to 6 men.

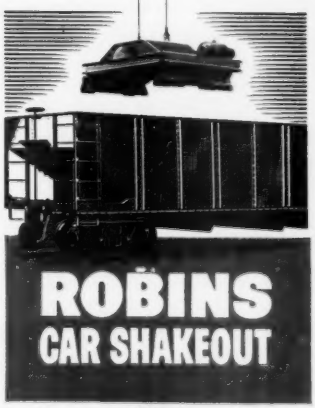
Now that's all changed! *With a Robins Car Shakeout, you can empty a car "broom-clean" in only a few man-minutes.* At most you need only 2 men; often one will do, since the entire unloading operation is completely mechanical.

You see, the Robins Car Shakeout shakes the material in the car loose . . . with no damage to the car . . . no danger to the operator. It does such a thorough and efficient job that the load flows freely and quickly through the hopper doors. That's true no matter how tightly the load is packed. Small wonder, then, that you can slash demurrage costs with the Robins Car Shakeout!

In short, you save time . . . you save money . . . you save manpower. Field operations by hundreds of users prove that this method of unloading cars is as much as 12 times faster than manual unloading.

Find out more about the Robins Car Shakeout. Write Robins today!

A note on your company letterhead to Dept. P-3, Robins Conveyors Division, Passaic, N. J., will bring you this new booklet about the Robins Car Shakeout. Or ask for a Robins engineer to tell you the complete Shakeout story in person. No obligation!



ROBINS CAR SHAKEOUT

ROBINS CONVEYORS DIVISION, Hewitt-Robins Incorporated, Passaic, N.J.

North • East • South • West . . . It's Schramm

. . . doing jobs like these in Your Field

At almost every turn you need compressed air!

The check list (at right) indicates some of the many compressed air jobs to be done, all of which are accomplished easily, quickly and economically with Schramm Air Compressors.

Here's *why* you profit, as others have, by using Schramm: they're compact, lightweight, easy to start; built for rugged jobs, to provide a continuous flow of air.

Important features include 100% water cooled; mechanical intake valve; forced feed lubrication and easy starting.

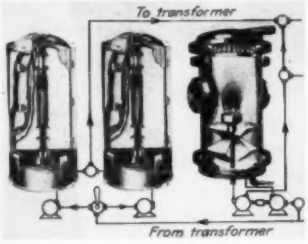
Performance everywhere has proved Schramm Air Compressors can do any compressed air job you require. Write today for list of models and sizes.

- Operating Pneumatic Hammers and Drills
- Air Chucks
- Sandblast for Cleaning Metals
- Belt Shifters for Heavy Machine Tools
- Cleaning Machines with the Air Jet
- Air Hoist Machine Shop Applications
- Air Motors for Grinding, Buffing, etc.
- Matching Flanges
- Grooving Bearings
- Ejecting Work From Presses
- Pumping Water
- Punches and Presses
- Supplying Power Hammers, Lifts and Jacks
- Operating Drop Hammers
- Spraying Metal
- Spraying Paint
- Operating Precision Measuring Devices

SCHRAMM INC.

THE COMPRESSOR PEOPLE • WEST CHESTER • PENNSYLVANIA

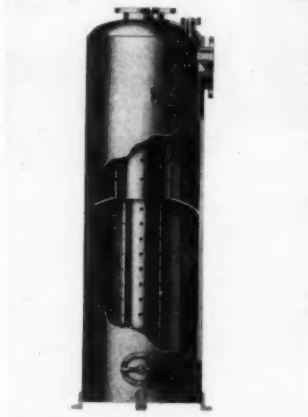
where contamination can be picked up. For variations in frost-line depth, the hydrant can be furnished to order for burying to depths of 3 ft and 5 ft. Open end of spout, which is of 1-in. pipe, is threaded with standard threads for a hose adapter. **Crane Co, 836 South Michigan Ave, Chicago 5, Ill.**



Oil Purifying System E138

UNIT CONSTITUTES a complete system for purifying, dehydrating and degasifying insulating oil either in field or central station. Use of two purifiers with a separate pump and motor provides greater flexibility by providing a choice of two absorbent dosages.

Use of the specially processed absorbent removes such contaminants as colloidal carbon, organic acids, sludge and dirt. Dehydration chamber is a cylindrical shell with heater bands and insulation to maintain proper wall temperature, preventing condensation. **Honan-Crane Corp, 200 Superior Ave, Lebanon, Ind.**



Exhaust Snubbers E150

SIDE-INLET EXHAUST SNUBBERS are for all 2- and 4-stroke cycle stationary gas engines (operating on either diesel or otto cycle) requiring control of exhaust explosions during starting, as well as continuous suppression of sparks. Designated as Series *SDL*, these units are available in pipe sizes 5 to 30 in., inclusive.

SDL series snubber incorporates a *Fog-*

(*Continued on page* 184)

Bulletin on SUPER REFRACTORIES by CARBORUNDUM

TRADE MARK

NO. 1 MARCH, 1949

Where Do Super Refractories Fit?

Super Refractories, as produced by CARBORUNDUM, are designed to augment the more commonly-used refractories. They fit in where the latter materials, for one reason or another, do not measure up to thermal, physical and or chemical requirements.

The characteristics of super refractories by CARBORUNDUM often make them the logical first choice in terms of cost of production or quality of work produced. High heat resistance is an outstanding property. These brick, tile and shapes stand up under temperatures that lead to the failure of other refractories. However, super refractories by CARBORUNDUM are often specified for other product properties . . . even at relatively low temperatures.

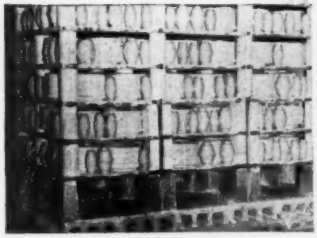
In effect, the line of super refractories by CARBORUNDUM are specialized products—custom-built—for specific requirements. They provide effective resistance to abrasion, spalling, chemical corrosion and thermal shock. They stand up under fast and frequent temperature changes.

The use of super refractories by CARBORUNDUM . . . either in complete structures or in localized trouble areas . . . results in longer refractory life, lower replacement cost, uniform production cycles, faster and less frequent cleaning and stepped up production. They give you lowest all-around refractory cost per product unit. Support for this fact is given in the installation data reported in this bulletin.

Physical Properties of Super Refractories by CARBORUNDUM

TRADE MARK

	CARBOFRAX	MULLFRAX	MULLFRAX S	ALFRAX K	ALFRAX B	ALFRAX BI
Heat Conductivity at 2200°F. in BTU/hr. sq. ft. and °F. /in. of thickness	109 BTU	15 BTU	9 BTU	21 BTU	12 BTU	7 BTU
REFRACTORINESS PCE CONE	37-40	38-39	37-38	37-39	39-40	38
SPALLING RESISTANCE	High	High	High	Medium	Good	Good
ABRASION RESISTANCE	High	Medium	Medium	High	Medium	Low
THERMAL EXPANSION	Low	Medium	Medium	Medium	Medium	Medium
SPECIFIC HEAT	0.285			0.330		0.320
WEIGHT 9 IN. STRAIGHT	9.25 lbs.	9.5 lbs.	7.8 lbs.	10.1 lbs.	7.25 lbs.	4.5 lbs.



Switch to Super Refractories Increases Load "Fill" by Over 15%

Increased capacity plus considerable savings in time, money and trouble more than justify the change-over from saggers to open setting of super refractories in the case of this hotelware plant. Setters and posts support the ware load on kiln cars put through a direct fired continuous kiln on a 72 hour cycle. Operating temperature is 2300°F.

Since the switch to CARBOFRAX silicon carbide setters and MULLFRAX electric furnace mullite posts—output has increased, rejects and costs are lower. Extended service life and thermal shock resistance cut down the necessity of frequent car rebuilds . . . offer additional savings in both labor and material costs.

Super Refractories Withstand an 11 Year "Beating"

The super refractory brick installed in the fuel bed of this boiler furnace has been in continuous on-line service for more than a decade. CARBOFRAX silicon carbide brick has given this cost-cutting performance under conditions of flame erosion and mechanical abrasion as well as high temperatures. Its hard dense face resists clinker embedment and is unharmed by barring and cleaning. It possesses a high refractoriness as well. That is why it provides an excellent foundation for upper walls while preventing frequent outages in the hot punishment zone.

For these same reasons, CARBOFRAX brick and flue linings are preferred in water gas machine installations where their service provides more gas make at lower cost per MCF of gas produced.

"Carborundum," "Carbofrax," "Mullfrax," "Silfrax," "Alfrax" are registered trademarks which indicate manufacture by The Carborundum Company

Address all correspondence to: Dept. K-39, THE CARBORUNDUM COMPANY, Refractories Division, Perth Amboy, New Jersey

Continued on other side ➡

← Continued from other side

Super Refractory Slag Hole Blocks Assure Continuous Runs

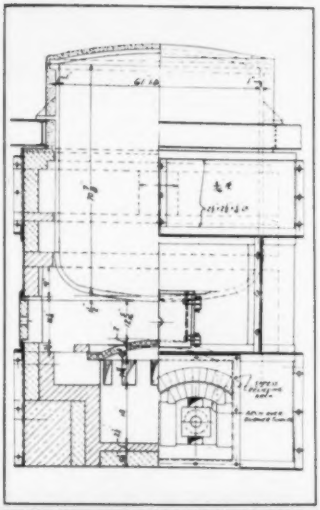
CARBOFRAX silicon carbide slag hole blocks are particularly resistant to slag erosion at high temperatures. A uniform hole size is maintained throughout continuous pour cupola runs—with no enlargement even when the blast is on. A constant slag stream is assured for twenty-four and even more hours. Costly shutdowns for replacement are avoided. Slag hole blocks are immediately available from stock in standard sizes. Special sizes are made to order.

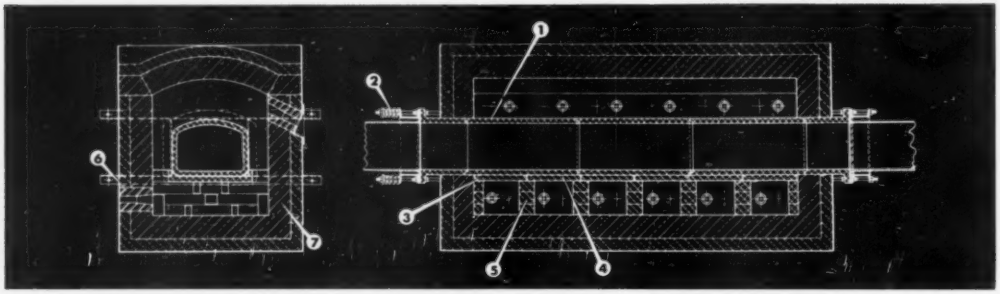
Unique Properties Provide Advantages in Low Temperature Applications →

Because super refractories are so closely identified with high temperatures, their advantages in the low temperature range are often overlooked. In this application, the charge is only heated to 350°C. Yet, because of a thermal conductivity 11 to 12 times that of fireclay, the CARBOFRAX silicon carbide arch radiates heat to the pot faster. Working temperature is attained with a reduced heat head.

Combustion chamber temperatures are lower. Because gases are at lower temperatures around the cast iron pot they are not as destructive. Life of both kettle and setting are extended with no repairs required after 5 years of service. Formerly, pots lasted about 6 months.

As a further aid to heat transfer, the CARBOFRAX arch may be half the thickness of fireclay—yet possess 3 to 4 times the mechanical strength. Strong resistance to cracking and spalling assures long, trouble-free service. This same advantage is realized in controllable off-take ports, lined with MULLFRAX S converted kyanite brick, which easily withstand temperature fluctuations.





Muffle Furnace Installation Exemplifies Versatility and Variety of Super Refractories

Several types of super refractories by CARBORUNDUM are used to advantage in this large muffle furnace with artificial atmosphere which employs sectional muffle with support plates and end compression.

1 The sectional CARBOFRAX muffle assures extended service with freedom from cracking and mechanical wear or frequent replacement. Exceptional refractoriness permits more continuous higher temperature operation without deterioration. At a lower initial cost, CARBOFRAX muffles approach the thermal conductivity of alloy steel at working temperatures. Furnace production is increased. Fuel cost remains about the same. Maintenance expenses drop.

2 Tight joints to prevent leakage of artificial atmosphere and permit muffle expansion and contraction are provided by spring compression.

3 CARBOFRAX support plates provide a continuous level bearing for the muffle. They are unaffected by high temperatures and resist cracking.

4 Various units are free to move independently on heating and cooling because of a special bedding cement developed to prevent sticking. This feature also simplifies any necessary replacements.

5 MULLFRAX or CARBOFRAX piers provide excellent support because they retain a high load-bearing strength at high temperatures. After extended service, there is no sagging or slumping.

6 Less attention is required for burner tunnels rammed with ALFRAX cement or formed with MULLFRAX S prefired blocks. Resisting flame erosion, spalling and cracking—they help maintain the hole size and thereby provide more efficient combustion conditions.

7 ALFRAX BI or MULLFRAX S linings withstand extreme high temperatures for extended periods without deformation. Heat is retained because of a low thermal conductivity. Worthwhile savings are realized. More continuous furnace operation is assured.

A complete file of informative literature covering super refractories is available through The Carborundum Company. There are facts and figures on installations in specific fields. To obtain copies of reports, booklets and catalogs of particular interest is a simple matter. Merely select from the list printed here. Copies will be sent you at once. No obligation, of course.

Super Refractories by CARBORUNDUM (general catalog)

Super Refractories for the Ceramic Industry

Super Refractories for the Process Industry

Super Refractories for Boiler Furnaces

Super Refractories for Heat Treatment Furnaces

Super Refractories for Gas Generators

The FRAX Line of SR Cements

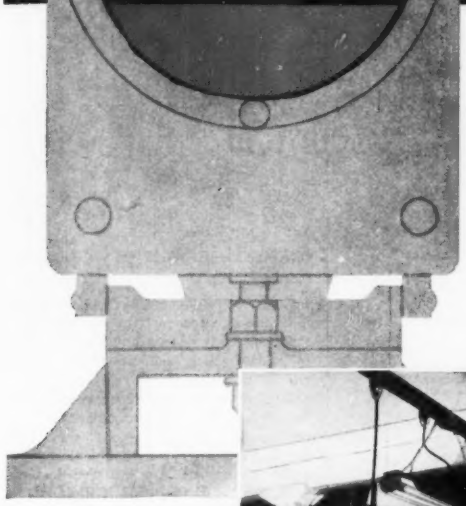
CARBOFRAX Refractories Skid Rails

Bulletins Nos. 1, 2, 3 on Underdrain Systems and Diffuser Media.

Dept. No. K-39

THE CARBORUNDUM COMPANY
Refractories Division
PERTH AMBOY, NEW JERSEY

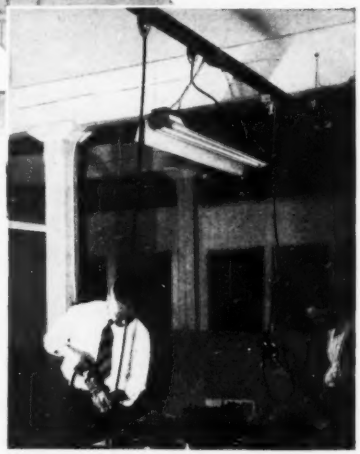
You get 6 big advantages with New LTG Flex-a-Power...



The only unusually rugged plug-in or trolley busway in 2, 3 or 4 pole construction in one compact housing.

Pre-fabricated LTG FLEX-A-POWER — rated 50 amps — 250 v, AC or DC — supplies power for fluorescent lights and power tools. It provides both trolley power take-off and a continuous outlet — you can tap at any point . . . ideal for industrial plants, offices, stores, arenas, work shops and garages. Here are more new features:

1. **EASY TO INSTALL** — simplified hanging and joining methods speed up installation.
2. **IT'S ECONOMICAL** — two or more circuits can be run in one housing — controlled separately.
3. **PERMITS BALANCED LOADS** — plugs or trolleys are polarized which provides a convenient means of balancing loads.
4. **IT'S REALLY RUGGED** — rigid construction of housing itself prevents sagging — only 2 hangers needed for each 10 ft. section.
5. **MORE FLEXIBILITY** — standard fittings such as elbows and radius sections permit economical custom installations — easy to disassemble and relocate.
6. **GREATER CONVENIENCE** — trolley with silver alloy contacts may be inserted or removed at any point along the run — no "drop-out" section required.



FOR MORE INFORMATION, write for circular TEC-3, THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn.

Men Who Observe the Best Electrical Practice Make It a Practice to Use

TRUMBULL (T) ELECTRIC

TRUMBULL'S TRAINLOAD OF NEW PRODUCTS

The company your boiler keeps . . .

APEXIORIZED

New boilers APEXIORized during the past year alone are serving these industries:

CHEMICALS	MACHINERY
FOODS	PUBLISHING
PETROLEUM	UTILITIES
BREWERIES	GOVERNMENT
TEXTILES	INSTITUTIONS
PAPER	MINING

Pick any industry where steam is generated for power or process and you've named a representative group of APEXIOR users — engineers who have proved the worth, in boilers large and small, of internal protective surfacing.

They know that even the strongest steel is powerless to resist moisture penetration — that water at its finest retains the capacity to impair — can never improve — bare steel. And so they separate the two, sealing boiler metal beneath a tissue-thin barrier of APEXIOR NUMBER 1.

Meeting steam and water is a surface that neither can dissolve — smooth, to deny a foothold to deposits — inert, so that it forms only a readily broken mechanical bond with any that adhere. The result, for the legion of APEXIOR users — —

- *maximum boiler availability — security against corrosion*
- *improved circulation, through friction-free tubes*
- *constant high heat-transfer efficiency*
- *easier, less frequent cleaning — lower maintenance cost*
- *speedier, positive inspection*
- *less outage time — longer on-the-line service*

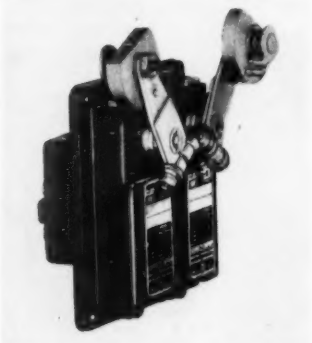
Write us for more facts about:

DAMPNEY maintenance for metal

THE DAMPNEY COMPANY of AMERICA • Hyde Park, Boston 36, Mass.

jet that sprays a cooling-water mist into the exhaust gases. Flame from the engine is also cooled and extinguished, while gas in the snubber is made noninflammable by the mist.

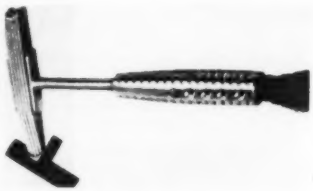
Exhaust slugs entering snubber spin off a deflecting plate. The spinning action scrubs and breaks up carbon and other foreign material. The gas then spins into second scrubbing section. Before exhaust gas emerges, glowing sparks have been "scrubbed out," and the two snubbing sections, connected by a compact coaxial tube arrangement, snub the slug of exhaust gas to prevent noise. **Burgess-Manning Co, Libertyville, Ill.**



Duplex Limit Switches E133

ORDINARILY USED on machine tools to limit travel in either of two directions, the duplex unit takes place of two separate limit switches. Only one conduit run is needed for control wiring, eliminating extra conduit and fittings between individual switches.

Both flush and surface mounting types are available. Units are rated at 600 v and operate in temperatures to 200 F. Each switch has a single-pole, double-throw snap action mechanism and two electrical circuits. **Square D Co, 4041 N Richards St, Milwaukee 12, Wis.**



Weld Cleaner E117

LONG WELD-CLEANING BRUSH of crimped, oil-hardened wire forms handle of the *Multi-Pic-Weld* cleaner. Handle has five adjustment points into which a flat head screw enters. As wire brush wears down, back out the flat head screw, pull wire brush out enough to take up the wear and screw back flat head screw into next adjustment point.

The cleaning head is a single hammer

FOR NEW POWER PLANT CONSTRUCTION OR EXPANSION . . .

Specify
STRUTHERS WELLS
HIGH PRESSURE
FORGED
HOLLOW BORED
TUBING
Readily Available in sizes up to 36 inches O.D. 50 foot lengths

New, high pressure boilers require the safety factor of Struthers Wells Heavy Walled, Forged, Hollow Bored Tubing for connecting the steam units to the turbines.

Phone, wire or write for specific information on your requirements.

Struthers Wells

OFFICES IN PRINCIPAL CITIES

STRUTHERS WELLS CORPORATION
TITUSVILLE FORGE DIVISION
TITUSVILLE, PENNA.

plants at { TITUSVILLE, PENNA. / WARREN, PENNA.

When you need specific information on materials or equipment, reach for your Sweet's File for Power Plants (the big red file). It contains 118 manufacturers' catalogs full of useful information on thousands of products... from absorbers—gas, to zeolite. Cross indexing speeds finding.

If Sweet's File for Power Plants is not available in your office, make request immediately for application form. Files are distributed FREE to those qualified.

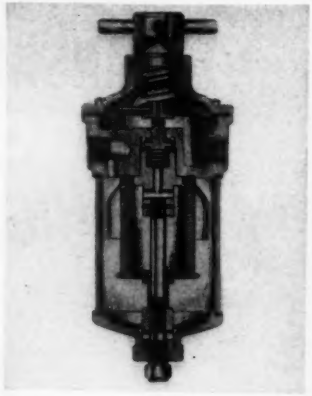
Sweet's

CATALOG SERVICE

for easier, faster selection of products

119 W. 40th ST., NEW YORK 18, N. Y.

with five pick-pointed leaves of hardened tool steel. As they wear they can be resharpened on an ordinary grinding wheel. **Bernard Welding Equipment Co, 741 East 71st St, Chicago 19, Ill.**

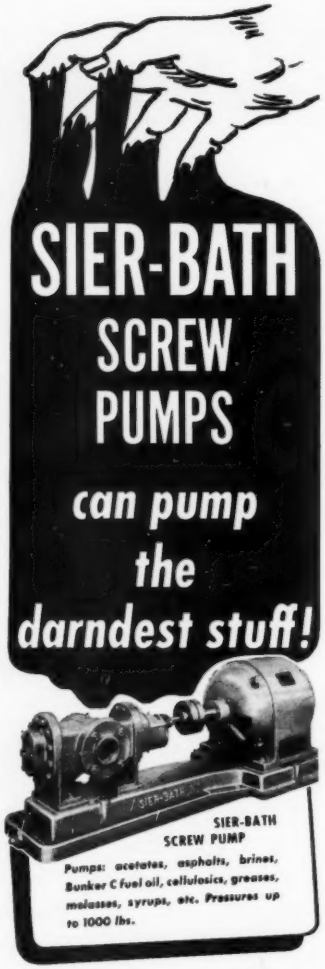


Regulator Filter E109

MODEL FH-15 REGULATOR-FILTER combines features of reducing valve and air filter for instrument service requirements. Parts are forged brass or stainless steel. Regulator is a *Cono H*-15 unit with composition seats to provide tight shutoff. It also incorporates a relief valve. Filter is phenolic-resin impregnated cellulose cylinder capable of removing particles as small as 40 microns. Chamber below filter serves as sump for oil and water accumulation. Through-bolt construction permits removing filter element without disturbing pipe connections. **Conoflow Corp, Philadelphia, Pa.**

Water Regulator E123

POSITIVE SHUT-OFF, balanced supply-line pressure can be had with Model *W*, Series 2000 modulating condensing-water regulator. The valve operates in refrigerating circuits using Freon 12, 22, methyl, sulphur and ammonia. Important features are: (1)


SIER-BATH
SCREW
PUMPS
can pump the darndest stuff!
SIER-BATH
SCREW PUMP
Pumps: acetates, asphalts, brines, Bunker C fuel oil, cellulosics, greases, molasses, syrups, etc. Pressures up to 1000 lbs.

No matter how gooey the stuff, it can't "gum up the works" in a Sier-Bath Screw Pump. The powerful thrust of its screw moves materials so viscous that they are often in a semi-solid condition.

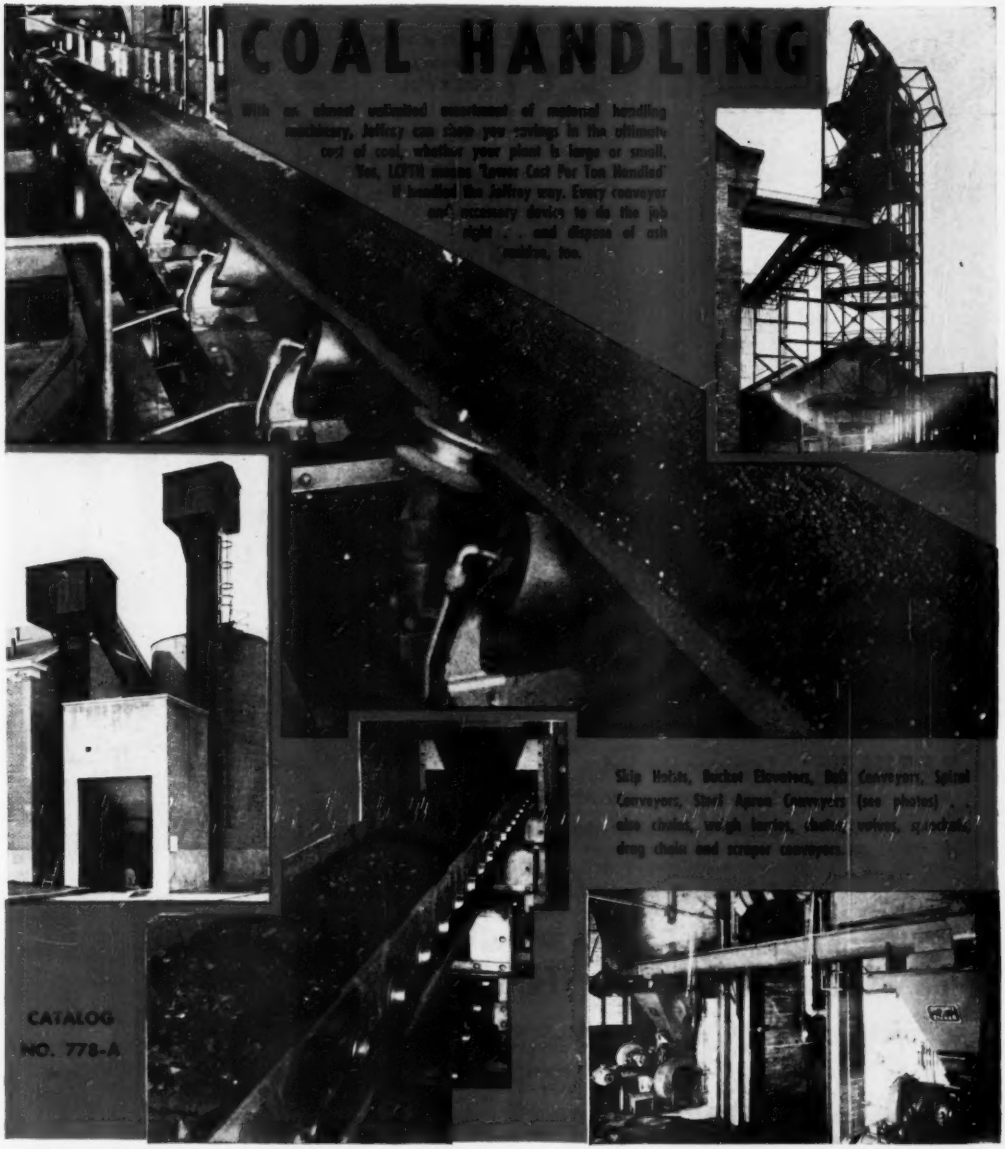
The simple design (only two moving parts) and accurate but sturdy construction, make these screw pumps long-lived and keep them relatively free of maintenance. They are available in horizontal and vertical models. Send for booklet.

ALSO MANUFACTURERS OF SIER-BATH GEAREX ROTARY PUMPS AND SIER-BATH PRECISION GEARS

FOUNDED 1905 MEMBER A.G.M.A.

Sier-Bath
GEAR and PUMP CO., Inc.

9254 HUDSON BLVD., NORTH BERGEN, N J

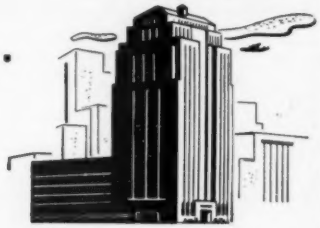

COAL HANDLING
With an almost unlimited assortment of material handling machinery, Jeffrey can show you savings in the ultimate cost of coal, whether your plant is large or small. Yes, LOWER means 'Lower Cost Per Ton Handled' if handled the Jeffrey way. Every conveyor and accessory device to do the job right . . . and dispose of ash modern, too.
Skip Hoists, Bucket Elevators, Belt Conveyors, Spiral Conveyors, Steel Apron Conveyors (see photos) . . . also chains, weigh larries, chain, valves, sprockets, drag chain and scraper conveyors.
CATALOG NO. 778-A
THE JEFFREY MANUFACTURING COMPANY
932 North Fourth St., Columbus 16, Ohio
ESTABLISHED 1877
Complete Line of Material Handling, Processing and Mining Equipment

CORAVOL CASE HISTORY NO. 3

3rd in a series describing CORAVOL results in steam systems

Type of Operation...

OFFICE BUILDING



OPERATING CONDITIONS: 38 story building.
1900 radiators.
37,500 square feet of radiation.

PROBLEM: Corrosive attack on lines of steam system.
Rusty condensate.
Rust deposits throughout the system.
Lack of uniform and dependable heating.

CORAVOL STARTED: December 1940.

RESULTS: Corrosion checked.
Rust deposits cleaned out of system.
Better steam circulation. Uniform heat.

USER COMMENTS: Substantial reduction in fuel cost.

CORAVOL (the original* AMINE PROCESS)

STOPS CORROSION IN YOUR STEAM SYSTEM

CORAVOL in your steam system (1) prevents corrosion in lines, (2) cleans out clogging rust deposits. Thus, CORAVOL *protects lines;* improves heat transfer; restores original capacity of lines and efficiency of valves and traps.

CORAVOL is *not* a boiler feed water treatment—it is designed expressly for use in steam systems. Because **CORAVOL** volatilizes and condenses with the steam, it circulates throughout your entire steam system and protects *all* zones from corrosive attack.

CORAVOL IS PART OF A COMPLETE TECHNICAL SERVICE which provides special formulas of treatment for: boiler feed water . . . hot water supply . . . refrigerating brine . . . cooling and condenser water . . . rapid scale removal . . . coagulation . . . algae control . . . fuel oil supply.

*The use of CORAVOL in steam systems is covered by U. S. Patent No. 2053024. The Western Chemical Co., owner of this patent, grants licenses under which volatile AMINES purchased from other sources may be used in steam systems upon payment of royalty to Western Chemical Co.

WRITE TODAY for complete *free* data about the CORAVOL process.

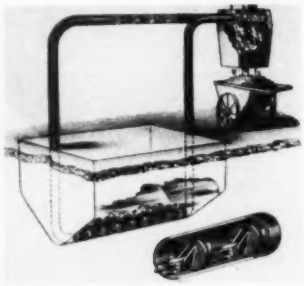
WESTERN CHEMICAL COMPANY

713 Washington Street — Kansas City 6, Missouri

valve has 95% capacity with as much as a 15-lb increase in head pressure (2) valve closes tight on a 5-lb decrease in head pressure under opening point (3) an adjustable spring counter balances supply-line water pressures up to 150 psig (3) no packing, pistons or rubber sleeves are used. **Metrex Valve Co, 9900 Franklin Ave, Franklin Park, Ill.**

Bar Bender E1C2

COLD BENDS, on the job, of copper, aluminum, brass and mild-steel bar and strip through a complete range of sizes from ⅛x1 in. to ½x6 in. are possible with the Form-Bar Bender. Bender is portable and simple to operate. **Graybar Electric Co, 420 Lexington Ave, New York 17, N. Y.**

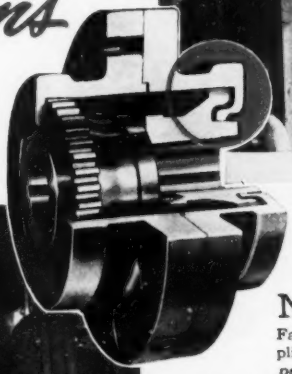


Continuous Conveyor E142

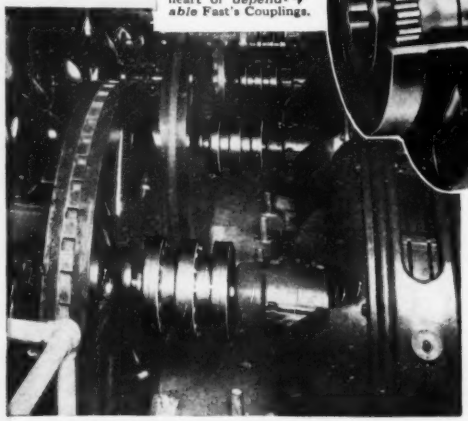
CONVEYOR MOVES ANY MATERIAL that settles to bottom of a tank, hopper, bin or other form of reservoir. It consists of a series of neoprene or cast-iron flights, assembled on an endless chain. The chain and flights are pulled through a pipe casing by a high-torque gear transmission. The casing, custom-bent to specifications, is 2, 4 or 6 in. in diameter, depending on capacity requirements of the particular installation. Structural design is such that chain and flight move smoothly. The casing has open sections at the pick-up and release points in the conveyor system. Material to be trans-

Here's Freedom from *Coupling Shutdowns* for ALL INDUSTRIES

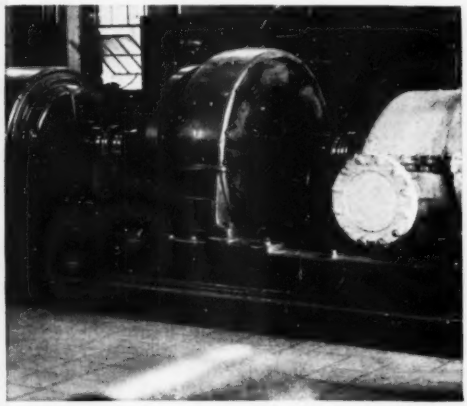
IN OIL FIELDS Fast's are in service to compensate for shaft misalignment, in all kinds of weather, subject to moisture, dirt and grit . . . yet they transmit power without costly coupling shutdowns!



Here's the exclusive "rocking bearing," heart of *dependable* Fast's Couplings.



CHEMICAL PROCESSING plants use Fast's Couplings because *exclusive* metal-to-metal seal keeps out impurities—eliminates lost time due to coupling failure! These Couplings have been in service since 1922!



POWER PLANTS use Fast's Couplings to correct shaft misalignment because *exclusive* metal-to-metal seal and the absence of perishable parts virtually eliminate shutdowns.

NO matter what you make—no matter how much horsepower you use in a year—Fast's Couplings virtually eliminate all coupling failure in your plant! There are *no perishable parts* to wear or fail in Fast's! Nothing to replace . . . they're easy to maintain. Even the load-carrying oil is *completely guarded* by a positive metal-to-metal seal formed by exclusive "rocking bearing" principle of construction.

With Fast's on your job you can forget about coupling shutdowns. Correctly engineered position of oil-protecting "rocking bearing" allows for *freedom of movement* to compensate for misalignment because its *spherical base* has *the same axis* as the hub spline faces. No perishable packing rings are used at this critical spot . . . or elsewhere!

When you order Fast's you get years of top engineering experience, Koppers' high standards of workmanship and unexcelled service, including available parts if required by change of drive, *even if your Fast's have been running for 30 years!* For full information mail the coupon below. Address Koppers Co., Inc., Fast's Coupling Dept., 243 Scott Street, Baltimore 3, Md.

KOPPERS

FAST'S *Self-Aligning* **COUPLINGS**

SEND FOR FREE CATALOG!

KOPPERS CO., INC., FAST'S COUPLING DEPT., 243 Scott Street, Baltimore 3, Md.

Please send me the free catalog that gives complete detailed information about Fast's Couplings.

NAME.....TITLE.....

COMPANY.....

ADDRESS.....

CITY.....ZONE.....STATE.....

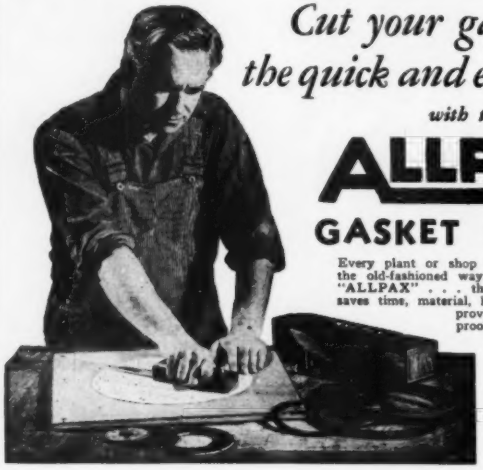
mail today

Cut your gaskets the quick and easy way

with the

ALLPAX

GASKET CUTTER



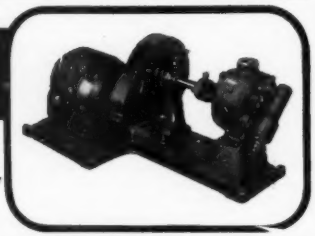
Every plant or shop now cutting gaskets the old-fashioned way by hand, needs an "ALLPAX" . . . the gasket cutter that saves time, material, labor and money. It provides a simple, foolproof method of cutting which can be done by anyone. Saves its cost in the first few gaskets cut. Cuts clean, accurate gaskets in any packing material from 1" to 36" diameter.

Furnished complete with six (6) double-edge cutting blades and one (1) 18" cutting board . . . all packed in durable hardwood case with hinged cover . . . ready for any gasket cutting job. Price $19.50 complete equipment, f.o.b. Mamaroneck, N. Y. ORDER NOW.

THE ALLPAX CO. INC.

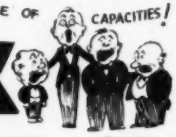
Mamaroneck, N. Y.

You get these ... and more with



COMPLETE RANGE OF CAPACITIES!

VIKING PUMPS



That's right . . . with a Viking, you get a tough, rugged pump, one with long life, one with only two moving parts, one that will pump any clean liquid regardless of viscosity and the most complete range of capacities, sizes and styles from which to choose.

PUMPS ANY CLEAN LIQUID!

But added to this, you get . . .

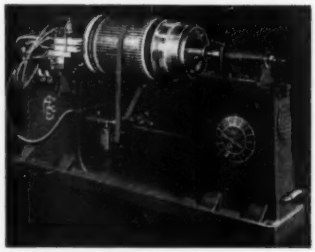
Self priming (no added gadgets)—Smooth, even discharge—Low speed—long life—And a dependable pump that is built to do the job intended.

With a Viking, you get the right pump for the job. Ask for free folder 495W today.

See Our Catalog in SWEETS

Viking PUMP COMPANY Cedar Falls, Iowa

ported is picked up from the bottom of the reservoir and carried to delivery point and released. Conveyor is adapted to handling a wide range of materials. **Honan-Crane Corp, 962 Sixth St, Lebanon, Ind.**



Brazing Machine E126

BRAZING AND SILVER SOLDERING of generator and armature coil ends in repair shops can be sped up with the manufacturer's *CBG-24*. Unit can accommodate armatures from 18 to 42 in. dia. It has a built-in, heavy-duty 24-kva transformer with auto-regulating coil and 8-point heat-control selector. Dimensions are 49x24x99 in. and it weighs 2400 lb. **American Electric Fusion Corp, 261 W Diversey Place, Chicago 47, Ill.**

Lamp and Starter Tester E137

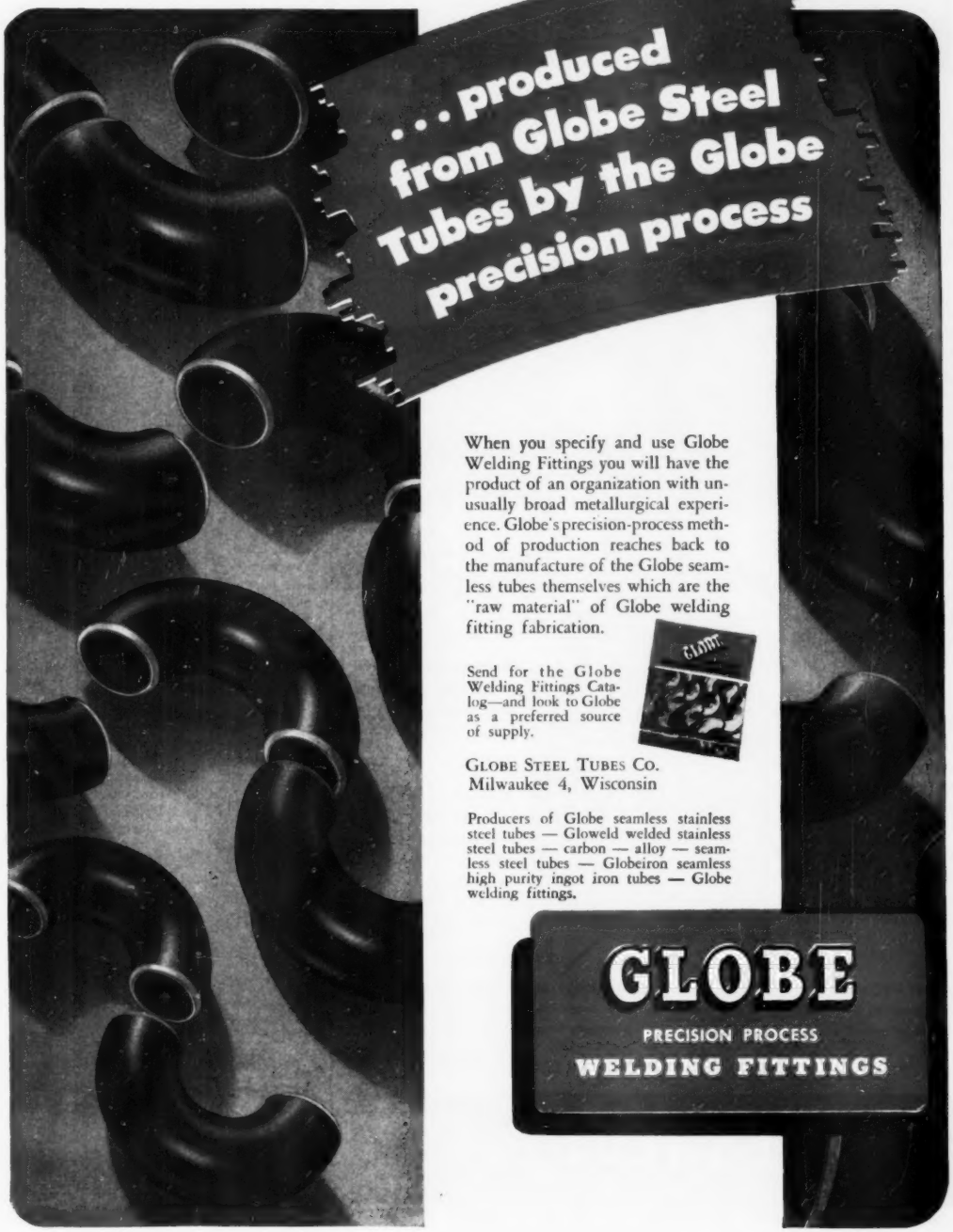
THIS DEVICE is designed to test fluorescent lamps and starters when trouble occurs with units in actual operation. Lamp giving trouble is slipped through support bracket and one end inserted in pin socket on tester base. Cord with socket attached connects to other lamp end.

Starter is tested by inserting in socket to right of lamp pin base. Indicator lamp under metal guard starts blinking if starter is good. **Compco Corp, 2251 W St. Paul Ave, Chicago 47, Ill.**

Heating Boiler E115

HOT-WATER HEATING BOILER, said to be ideal for panel, gravity or forced-feed applications, come in three sizes: 250,000 Btu output (8 boiler hp); 550,000 Btu (16 boiler hp); 730,000 Btu (22 boiler hp). All units

GLOBE WELDING FITTINGS



When you specify and use Globe Welding Fittings you will have the product of an organization with unusually broad metallurgical experience. Globe's precision-process method of production reaches back to the manufacture of the Globe seamless tubes themselves which are the "raw material" of Globe welding fitting fabrication.

Send for the Globe Welding Fittings Catalog—and look to Globe as a preferred source of supply.

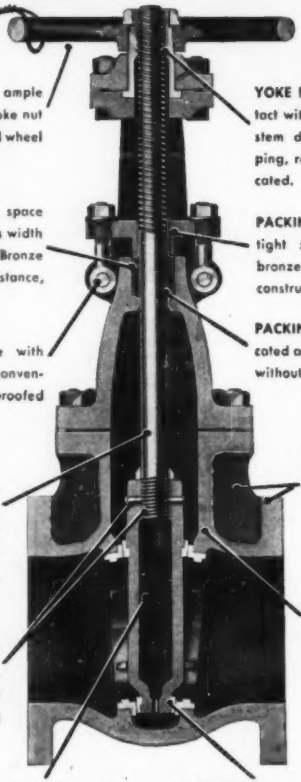
GLOBE STEEL TUBES CO.
Milwaukee 4, Wisconsin

Producers of Globe seamless stainless steel tubes — Gloweld welded stainless steel tubes — carbon — alloy — seamless steel tubes — Globeiron seamless high purity ingot iron tubes — Globe welding fittings.

GLOBE
PRECISION PROCESS
WELDING FITTINGS

Precision Engineering Makes this KENNEDY VALVE Rugged and Dependable . . .

KENNEDY STANDARD IRON BODY WEDGE GATE VALVE Fig. 0611, outside-screw-and-yoke. Service up to 125 lb. p.s.i. steam; 200 lb. p.s.i. water, oil or gas. 1½" through 48" sizes available.



HANDWHEEL, large, for ample leverage . . . secured to yoke nut by large bronze, hexagonal wheel nut, readily removable.

STUFFING BOX, packing space depth is more than 4 times width for longer packing life. Bronze bushed for corrosion resistance, durability.

BOLTS, swing eye type with washer nuts, for greater convenience in repacking. Rust-proofed to prevent corrosion.

STEM, rolled bronze, liberal diameter, for high tensile and torsional strength. Top seat collar permits repacking under pressure.

STEM AND DISC threaded together, prevented from turning by nickel copper alloy pin with ends riveted over.

WEDGE DISC, reversible and interchangeable, reinforced by integrally cast interior posts. Openings permit drainage in any position.

YOKE NUT, bronze, thread contact with stem at least 1½ times stem diameter eliminates stripping, reduces wear, easily lubricated.

PACKING GLAND machined for tight seal with stuffing box, bronze-bushed at stem. Slotted construction simplifies repacking.

PACKING, molded rings of lubricated asbestos maintain tightness without excessive gland pressure.

FLANGES are heavy and well filleted. Flanged ends have reinforcing ribs for extra strength.

BODY AND BONNET, Kennedy Higher Strength Cast Iron, generous metal thicknesses and well rounded corners provide maximum strength.

DISC RINGS, bronze, wide and thick, forced into dove-tailed grooves in disc to form practically integral construction.

Write for Bulletin No. 50. BUY FROM YOUR LOCAL DISTRIBUTOR

THE KENNEDY VALVE MFG. CO. 1060 EAST WATER ST. ELMIRA, NEW YORK

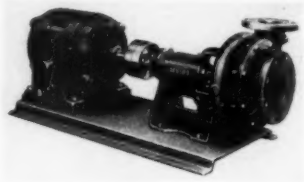
VALVES · PIPE FITTINGS · FIRE HYDRANTS

OFFICE-WAREHOUSES IN NEW YORK, CHICAGO, SAN FRANCISCO • SALES REPRESENTATIVES IN PRINCIPAL CITIES

have a minimum design pressure of 100 psi. Large unit, 22 boiler hp, is 113x44x26½ in. high and 26½ in. wide. **Cleaver-Brooks Co, 326 East Keefe Ave, Milwaukee 12, Wis.**

Chemical Feeder E107

ELVY FEEDER treats each boiler according to its individual needs. Chemicals used may be mixed to give desired results, but they must be in liquid form, free from solids. Feeder is controlled by differential pressure across a valve already installed in the boiler-feed line or a special differential valve will be supplied. **Elvy Co, South Bend, Ind.**

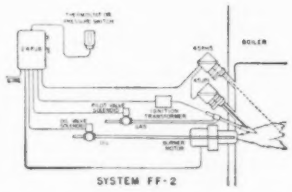


Clear-Liquid Pump E144

SINGLE-STAGE CENTRIFUGAL PUMP handles clear liquids in general water supply, circulating and transfer service, air conditioning, irrigation and similar uses. It is available in 14 sizes of 10 to 1800 gpm for heads up to 120 ft, in standard fitted and all-iron construction. Pump has enclosed impeller, ball bearings and is arranged for direct-motor or belt drive. **Goulds Pumps, Inc, Seneca Falls, N. Y.**

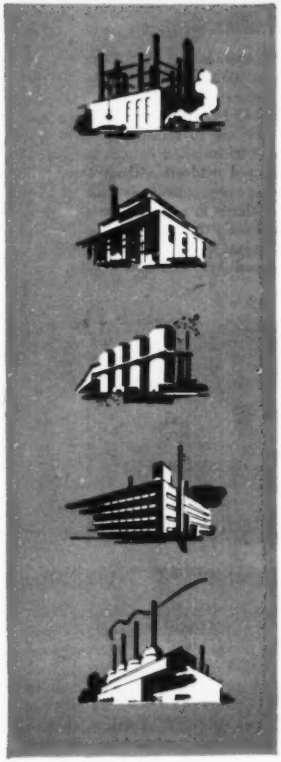
Coating Compound E112

COMBINED cleaning and coating compound, *Detrex* 79, is a yellow noncorrosive cleaning compound in a dust-free powder form. When applied in hot water at low concentrations to steel and other ferrous metals it leaves a light, blue-gray, crystalline phosphate film, said to be excellent as a base for a protective paint. **Detrex Corp, Detroit 32, Mich.**



Flame-Failure Device E55

INDUSTRIAL-oil flame-failure device supervises both pilot gas and main oil flame. Equipment, *System FF-2,* consists of (1) an electronic flame rod (2) photoelectric scanner (3) programming control. The flame rod polices the gas pilot flame. Should



for a New High in Performance!

THE PITTSTON COMPANY, one of America's largest producers of bituminous coal, adds a new name to its group of famous coals under the trade name of **COMPASS COAL.**

Production has just started at this multi-million dollar plant located on the B & O railroad. It has a capacity of 2,000,000 tons a year and will provide a new source of Fairmont steam coal. Compass Coal is mechanically mined and washed with the most modern equipment resulting in a product of high and uniform quality.

Complete engineering service is available to help you with your heating or power problems.

Distributed by

THE DAVIS COAL AND COKE CO.
BALTIMORE, MD.

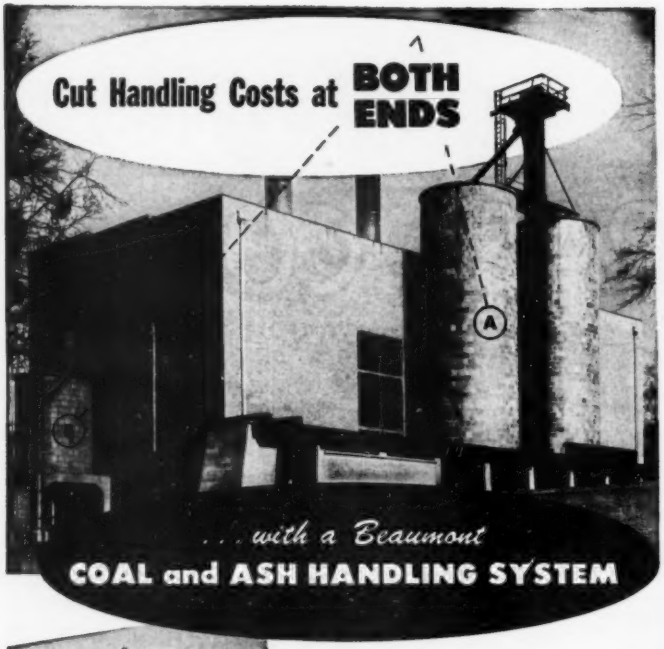
GLOBE COAL CO.
CHICAGO, ILL.

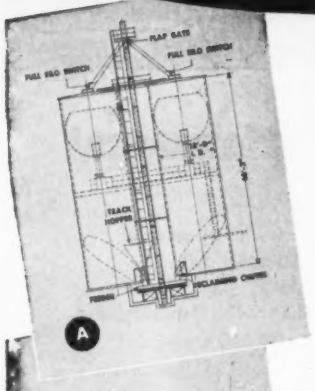
PATTISON & BOWNS, INC.
NEW YORK, N. Y.

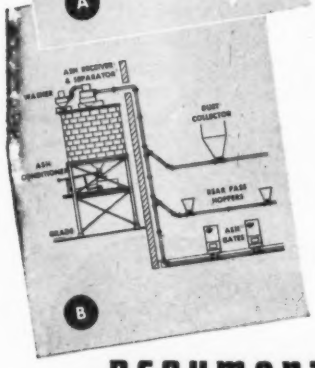
Subsidiaries of

THE PITTSTON COMPANY

COMPASS COAL
POINTS THE WAY







COAL HANDLING

With Beaumont Birch Coal Handling Equipment, one operator controls all coal from the time it arrives by rail and is dumped in the track hopper, through its lifting by bucket elevator, to its use —immediate or future.

ASH REMOVAL

The Beaumont "Vac-Veyor" system offers the most direct and economical method for removal of ashes, siftings, soot and dust. They are vacuum conveyed through a pipe from their source to an ash receiver and separator—then into the silo where they remain until final disposal.

Beaumont engineers design and erect this equipment—a complete coal and ash handling system. This brings you savings in installation as well as in handling costs—you have one contract, we have sole responsibility.

Write for more information to:

BEAUMONT BIRCH *Company*

1502 RACE STREET—PHILADELPHIA 2, PENNA.

Designers Manufacturers Erectors BULK MATERIAL HANDLING SYSTEMS

this fail to come on or be faulty for ignition purposes, the flame rod passes this information to the programming control to shut off the burner. The scanner monitors oil flame and links to programming control in much the same fashion as flame rod. **Combustion Control Corp, 77 Broadway, Cambridge 42, Mass.**

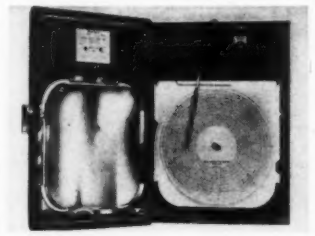
Drafting Template E120

CELLULOSE-NITRATE TEMPLATE carries all standard drafting symbols on a 4x3¼-in. dimensioner. Symbols on the No. 60 are beveled and precision-milled. **Rapidesign, Inc, P O Box 592, Glendale, Calif.**

High Tension Switch E131

SECTIONALIZING loaded subtransmission circuits up to 600 amp, the continuous current rating, is one of the applications of the new 23- and 34.5-kv switches. They are also suitable for use in transformer switching. Units may be installed indoors in a metal enclosure and outdoors without cover.

While opening, current is shunted from the main blades to an adjacent interrupter unit, permitting the main contacts to open without arcing. **S & C Electric Co, 4435 Ravenswood Ave, Chicago 40, Ill.**

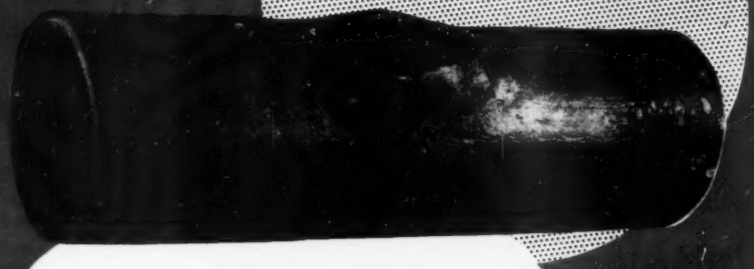


Work Recorder E104

RUNNING-COUNT RECORDER plots on a circular chart a curve of the number of operations against time. It records total count of intermittent operations and the time in which each occurs, and may be used to record work-producing operations or number of pieces produced. Total number of operations or pieces produced can easily be

PREVENT BOILER TUBE FAILURES OF THIS TYPE WITH—

DREW *Organic* SLUDGE CONDITIONERS



Adherent sludge and suspended matter will result in the failure of boiler tubes in the same manner as scale . . . by causing the overheating of tube metal. Generally accepted procedures for the prevention of scale involve proper chemical treatment and control. Sludge is formed in these processes. Drew Organic Sludge Conditioners, used in conjunction with proper chemical treatment, prevent the adherence of sludge and suspended matter to tube metal and eliminate failures of this kind.

A Drew Engineer will be glad to call on you to discuss sludge and any other water problems which you may have. No obligation.

POWER DREW CHEMICALS

E.F.DREW & CO. INC.
15 E. 26th ST., NEW YORK 10, N.Y.
Representatives in all key cities
BOILER WATER TREATMENT
COOLING WATER CONDITIONING

"GUNITE" Concrete

(SINCE 1915)

Linings for

STEEL BUNKERS •
DUCTS, HOPPERS •
STACKS •
UPTAKES •
BREECHINGS •
STEEL & PIPE •
ENCASEMENT •
FIREPROOFING •

GUNITE CONCRETE & CONST. CO.

1301 Woodswether Road

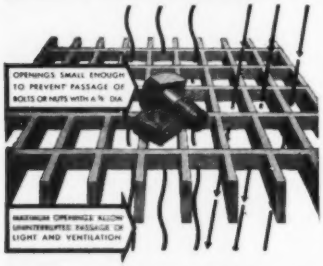
KANSAS CITY 6, MO.

R. N. Turner, Dist. Mgr., 228 No. La Salle St., Chicago 1, Ill. B. H. Mueller, Distr. Mgr., 6625 Delmar Blvd, University City, (St. Louis), Mo. Philip D. Barnard, Distr. Mgr., 2936 Addison, Houston 5, Tex.

Branch Offices: New Orleans, Dallas, Denver.

"See our catalog in Sweet's"

TRI-LOK RECTANGULAR OPEN STEEL FLOORING


OPENINGS SMALL ENOUGH TO PREVENT PASSAGE OF BOLTS OR NUTS WITH A ¾ DIA.
MAXIMUM OPENINGS ALLOW UNINTERRUPTED PASSAGE OF LIGHT AND VENTILATION

Tri-Lok strength is obtained by truss action through twisted cross-bar, curved in opposite directions at each bearing-bar. Standard openings in Tri-Lok Rectangular Steel Flooring are 1" x $3\frac{7}{8}$"—other size openings can be supplied as required.

Diagonal, or Super-Safety U-type Flooring, and stair treads of all types, are available. Bulletin KF 1140 describes the construction features of Tri-Lok Open Steel Flooring.

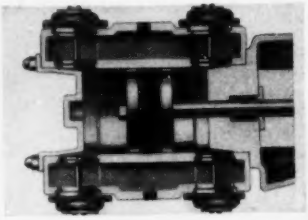
DRAVO CORPORATION

National Distributor for the Tri-Lok Company

Dravo Bldg., Pittsburgh 22, Pa.

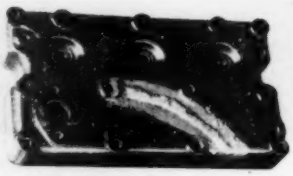
Sales Representatives in Principal Cities

found by multiplying number of complete pen traverses across chart by count per traverse for which the instrument is calibrated. **Bristol Co, Waterbury 91, Conn.**



Compressor Ring E100

MORGANITE self-lubricating carbon piston rings keep the compressor cylinder free of lubricating agents. Rings are chemically inert, impart no taste, color or odor. They are mechanically strong and may be reconditioned to compensate for wear before renewal is required. **Carbon Specialties Dept, Morganite, Inc, Long Island City 1, N. Y.**



Electrode E119

LOW-HEAT WELDING of cracks, breaks and worn parts can be made with *Eutectrode* 24/49. An improved procedure results from flux-coating that reduces required heat and avoids tensions in base metal. This procedure allows directing the alloy straight to metal surface without spatter or loss of material. It is reputed to be as easy to use as a mild-steel electrode, on ac or dc, straight or reverse polarity, and to give a completely machinable weld. **Eutectic Welding Alloys Corp, 40 Worth St, New York 13, N. Y.**

Vibratory Conveyors E148

FOR SUSPENSION OR BASE MOUNTING and powered by one or more vibratory motors supported either above or below the trough, depending upon space, these conveyors are available in different lengths and capacities. Conveyor handles hot, abrasive materials with sealed tubular troughs to convey dusty,

BELCO FULLY AUTOMATIC WATER SOFTENER INSTALLED IN MIDWESTERN MUNICIPALITY

The most recent advancement in automatic water softener control is illustrated above in the Belco motor operated single control valve. This plant produces 1.25 mgd of soft water with exceptionally low operating cost and minimum maintenance.

The unique features of the Belco Multiport Valve are that rubbing rotors are completely eliminated, pressure losses are reduced to a minimum and the high mechanical advantage makes it feasible to use a low H. P. electric motor for valve functions.

The saving in pumping and electrical costs for operating the multiport valve as well as the low chemical cost utilizing Belcolite Resins have resulted in a far more economical plant.

MODERNIZATION RESULTS IN LARGE OPERATING SAVINGS

The Belco automatic valve and Belcolite Resins can be applied to existing water softening installations to lower maintenance and chemical costs to such a degree that in most cases they will repay the original expense in a few months.

BELCO INDUSTRIAL EQUIPMENT DIVISION, INC.
56 Iowa Avenue Paterson 3, N. J.
Midwest: Deady Chemical Co., Kansas City, Mo.
South: Gulf Engineering Co., Inc., New Orleans, La.
Florida Industrial Equip. Distr., Miami, Fla.
Southwest: Watermasters Inc., Houston, Texas
Pacific: Deady Chemical Company, Los Angeles, Cal.

Belco

PROCESSES FOR REMOVAL OF WATER IMPURITIES

Announcing the **NEW**

"Engineered"

PIPE WRENCH

fully engineered

- ★ Modern functional design—only four parts—provides ideal lightness, strength and safety.
- ★ Exceeds Federal specifications: Type II Heavy Duty—GGG-W-651a.
- ★ Light in the hand—streamlined for weight-saving—palm-fitting handle.
- ★ Tough on the job—Roxco metal handle for maximum strength.
- ★ Positive grip with quick release—simplified cushion action.
- ★ Drop forged alloy steel replaceable insert jaws—teeth hardened by localized induction heat process.

fully guaranteed

against defects of material and workmanship

ROXCO

Look for this name and Trimont Mfg. Co. on each wrench — your assurance of better, longer service.

Here's the up-to-the-minute modern, fully engineered Heavy Duty Pipe Wrench that buyers and users have looked for. It's the new ROXCO — the advanced wrench design perfected and manufactured by the long experienced makers of TRIMO Tools. It is the ultimate result of new patterns and dies, new metallurgical formula — every part newly designed with modern engineering and crafting care to simplify and save weight while actually adding strength. We say — and you'll prove to your satisfaction — that the new ROXCO is a great addition to the famous Trimont line.

Write for catalog.

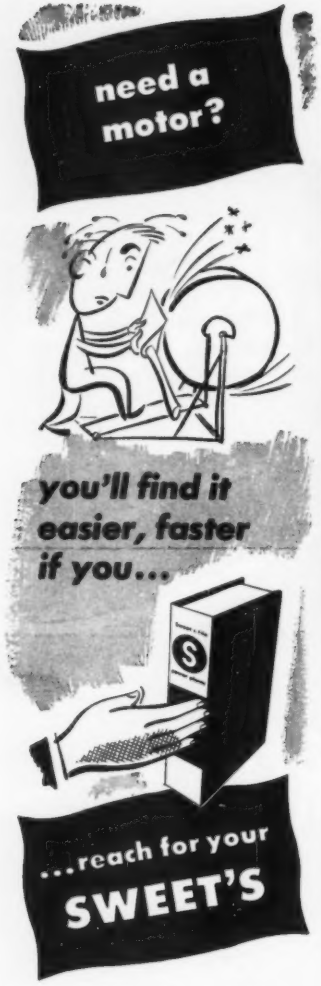
TRIMONT MANUFACTURING CO.

Division of Aetna Industrial Corp.

57 Amory Street, Roxbury, Boston 19, Mass.

Trimont Time Tested Tools

Pipe Wrenches • Chain Wrenches • Monkey Wrenches • Stillson Type Wrenches • Spud General Utility Wrenches • Saunders, Barnes and Other Type Pipe Cutters • Pipe Vises • Saw Vises • Kit and Portable Vises



When you need specific information on materials or equipment, reach for your **Sweet's File for Power Plants** (the big red file). It contains 118 manufacturers' catalogs full of useful information on thousands of products... from absorbers—gas, to zeolite. Cross indexing speeds finding.

If Sweet's File for Power Plants is not available in your office, make request immediately for application form. Files are distributed FREE to qualified organizations and individuals.

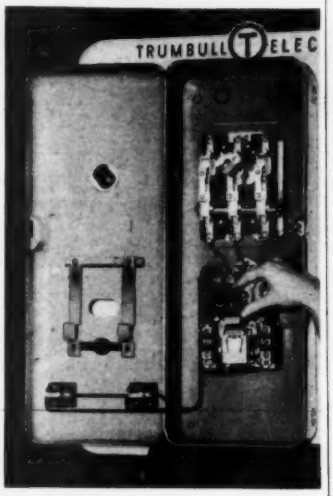
Sweet's

CATALOG SERVICE

for easier, faster selection of products

119 W. 40th ST., NEW YORK 18, N. Y.

poisonous materials or pure foods free from contamination. Trough is confined to the spring system of the vibratory motor and a dial switch provides variable control of the rate of material flow. **Syntron Co, Homer City, Pa.**



Motor Starter E129

DESIGNED TO START and provide running protection for ac motors up to 50 hp at 440 v, this combination starter and contactor features relay heaters and a plastic-encased coil.

Bimetallic heaters accurately follow heating curve of the motor and can be easily adjusted for automatic or manual reset. Plastic coil covering protects the windings from moisture, corrosion and abrasion. **Trumbull Electric Mfg Co, Plainville, Conn.**

Fluorescent Lamp E136

CHANGE OF CONSTRUCTION in the regular 60-in. T17, 100-watt lamp results in new lamp consuming only 85 watts while providing same light output.

No change has been made in the lamp's physical dimensions hence the new lamp is interchangeable with all 100-watt lamps. New construction is available in complete line of colors including daylight, 4500-deg white, white, soft white and *Warmtone*. **Sylvania Electric Products Inc, Salem, Mass.**

Paint Guide E114

PAINT SELECTION from a handy slide-rule selector may be made for industrial paint services. *Valdura* painting guide measures 4 by 9 in. To operate, set the slide at "surface to be painted" and small windows show preparation required, primer recommended, correct-finish coat, colors, characteristics of finish and the proper thinner. **American-Marietta Co, Chicago, Ill.**

CONTROL

Scale and Corrosion in Power Plant Equipment

WITH

Newly Perfected

Water Conditioning Chemicals

Recently developed applications of the newer colloids and surface-active agents in Wright Chemicals for power plants result in **improved** water conditioning — **positive** scale and corrosion control. Wright Chemicals contain 100% soluble, available chemicals—no waste or inert matter—insuring increased operating efficiency and reduced cost.

Boiler Water . . .

Corrosion and scale-forming compounds in boiler water can be controlled with Wright Chemicals.

Steam and Condensate Lines . . .

Steam and condensate lines can be properly protected by using Wright recommended formulas.

Cooling Jackets . . .

Efficiency of cooling jackets can be substantially increased by preventing corrosion and scale deposits on heat transfer surfaces.

Wright improved chemicals are the result of intensive study and research by men with years of experience in the development, production, application and control of water-conditioning chemicals.

Wright has no one cure-all to solve all problems. Each receives individual treatment. The Wright field engineer, who will call on you upon request, will obtain all necessary information and samples for examination in the modern Wright laboratory. Analyses are interpreted in view of supplemental information received, and recommendations made in the form of a proposal. Clients are provided with regular laboratory service as a periodic check upon conditions.

Send for new folder giving full details.

Wright CHEMICALS

WRIGHT CHEMICAL CORPORATION

Specializing in Water Conditioning

GENERAL OFFICES AND LABORATORIES

617 West Lake Street Chicago 6, Ill.

Offices in Principal Cities

Reader Service Page for . . .

NEW EQUIPMENT, TECHNICAL LITERATURE

Use the handy FREE service cards for additional information on this month's new products or for copies of latest trade catalogs.

AIR CONDITIONING, HEATING, REFRIGERATION AND VENTILATING

1 **EVAPORATORS AND CONDENSERS**—Bell & Gossett Co, Morton Grove, Ill. Catalog No. BJ-848 provides complete engineering data on the B & G Hydro-Flo direct-expansion evaporator line. Catalog No. EK-948 features B & G finned tube condensers in straight tube and "U" bend models.

2 **ROTARY POSITIVE BLOWERS**—Roots-Connersville Blower Corp, Connersville, Ind. 24-page bulletin No. 12-32-B-12 outlines some of the principle uses for rotary positive blowers. Operating advantages and principles are discussed, accompanied by several performance curves under various operating conditions.

3 **COOLING TOWERS** — Marley Co, Kansas City 15, Kan. 4-page booklet, entitled "What's Your Cooling Tower IQ on Water Distribution?" consists of a series of questions and answers on the subject.

BOILERS AND AUXILIARIES

4 **GAS-BURNER ASSEMBLIES**—Industrial Div, Bryant Heater Co, 1020 London Rd, Cleveland 10, Ohio. 6-page bulletin No. 7C presents Bryant Pow-R-Semblies, which are packaged industrial gas-burner assemblies complete with pressure blowers.

5 **REFRACTORY LINING** — Ironton Fire Brick Co, Ironton, Ohio. 4-page booklet presents Ironton Care-Line, a monolithic refractory lining. Directions for preparing Ironton Care-Line are included.

6 **ELECTROSTATIC PRECIPITATOR** — Koppers-Elex Precipitator Dept, Koppers Co, Baltimore 5, Md. Five booklets discuss Koppers-Elex electrostatic precipitators for boiler flyash removal, for cleaning blast furnace gas, for removal of dry dusts, for detarring and for sulphate pulp process.

ELECTRICAL EQUIPMENT

7 **STORAGE BATTERIES** — Electric Storage Battery Co, Allegheny Ave and 19th St, Philadelphia 32, Pa. 8-page booklet No. 4561 features Exide-Manchex batteries, in sealed glass, for all stationary power applications.

8 **SWITCHBOARDLESS GENERATORS**—Kato Engrg Co, Mankato, Minn. Catalog sheet gives advantages of Katolight switchboardless generators.

9 **MAGNETIC CONTACTORS**—Ward Leonard Electric Co, Mt. Vernon, N. Y. 4-page folder discusses Bulletin 4464 and 4465 ac magnetic contactors for commercial and industrial control applications.

10 **INSTRUMENT TRANSFORMERS** —General Electric Co, Schenectady 5, N. Y. 80-page booklet No. GEA-4626B contains detailed information on 197 types of standard instrument transformers.

11 **SYNCHRONOUS GENERATORS** — Allis-Chalmers Mfg Co, S 70th St, Milwaukee, Wis. 16-page bulletin No. 06B6139A covers construction and electrical characteristics of Allis-Chalmers' engine-type synchronous generators.

12 **INDUSTRIAL PLANT DISTRIBUTION SYSTEMS** — Westinghouse Electric Corp, P O Box 868, Pittsburgh, Pa. 32-page booklet gives complete colored diagrams of eleven basic dis-

HOW TO ORDER ADDITIONAL DATA

Be sure to fill out, completely, one coupon for each item of information you order. (See sample, right.) This gives your request authority and helps the manufacturer to address your copy completely.

When you have filled out completely one space for each item of information you want, detach along the scored lines and drop the cards in the mail.

Example

Write here number of item in which you are interested → 617

Your Company Name: Brown Mfg. Co.

Address: 3718 First Avenue, Pottsville, Okla.

Your Name: John Smith

Your Title: Power Engineer

POWER, 330 West 42nd St., New York 18, N. Y.

FILL OUT AND MAIL TODAY! NOT GOOD AFTER JUNE 1, 1949

Write here number of item in which you are interested →

Your Company Name:

Address:

Your Name:

Your Title:

POWER, 330 West 42nd St., New York 18, N. Y. 3/49

Write here number of item in which you are interested →

Your Company Name:

Address:

Your Name:

Your Title:

POWER, 330 West 42nd St., New York 18, N. Y. 3/49

Write here number of item in which you are interested →

Your Company Name:

Address:

Your Name:

Your Title:

POWER, 330 West 42nd St., New York 18, N. Y. 3/49

Write here number of item in which you are interested →

Your Company Name:

Address:

Your Name:

Your Title:

POWER, 330 West 42nd St., New York 18, N. Y. 3/49

Write here number of item in which you are interested →

Your Company Name:

Address:

Your Name:

Your Title:

POWER, 330 West 42nd St., New York 18, N. Y. 3/49

Write here number of item in which you are interested →

Your Company Name:

Address:

Your Name:

Your Title:

POWER, 330 West 42nd St., New York 18, N. Y. 3/49

tribution systems, detailed descriptions of operating principles of the systems and numerous photos of actual installations.

13 MOTOR CONTROLS — Industrial Controller Div, Square D Co, 4041 N Richards St, Milwaukee 12, Wis. Additional catalog sheets for Square D Company's electric motor control catalog include discussion of new equipment and prices.

14 MOTOR STARTERS — Allis-Chalmers Mfg Co, S 70th St., Milwaukee, Wis. 12-page bulletin No. 14B7132 describes line of ac full-voltage starters.

MAINTENANCE AND SAFETY EQUIPMENT

15 OIL SYSTEM—Gerin Mfg Co, 633 Broadway, Newark 4, N. J. 4-page booklet presents the Gerin electrically heated circulating heat-transfer oil system. Table of specifications is included.

16 MASONRY DRILLS — Super Tool Co, 21656 Hoover Rd, Detroit 13, Mich. Folder describes applications and advantages of new line of spiral-fluted, carbide-tipped masonry drills.

17 DUST COLLECTOR—Aget-Detroit Co, 574 Main at Washington, Ann Arbor, Mich. Bulletin No. A-548 gives specifications and ratings of Midget Model 325 dust collector, as well as recommendations for its installation and use on small surface grinders, bench, tool grinders, disk and belt sanders, etc.

18 INDUSTRIAL VACUUM CLEANER — Breuer Electric Mfg Co, 5100 Ravenswood Ave, Chicago 40, Ill. 4-page folder No. 588-48M discusses Breuer Tornado heavy-duty industrial vacuum cleaner.

MATERIALS HANDLING

19 ELEVATOR DUPLEX COLLECTIVE CONTROL — Otis Elevator Co, 260 Eleventh Ave, New York 1, N. Y. Bulletin No. B-726(5411) covers duplex collective control, a device that coordinates operation of two self-service elevators.

20 RECTANGULAR MAGNETS — Dings Magnetic Separator Co, 4740 W McGeogh Ave, Milwaukee 14, Wis. 12-page catalog No. 101-A describes Dings triple-pole high-intensity rectangular magnets for prevention of tramp iron damage to equipment, protection against fires, explosions, and product contamination, and recovery of tools and scrap.

21 ELEVATOR DOORS—Peelle Co, 47 Stewart Ave, Brooklyn 6, N. Y. 16-page bulletin No. 1949 gives construction details of Peelle freight elevator doors and car gates.

22 ELEVATOR OPERATING PANEL AND CAR SEATS — Otis Elevator Co, 260 Eleventh Ave, New York 1, N. Y. Bulletin No. B-536(5420) describes Otis signal control car operating panels. Bulletin No. B-515(5496) discusses folding car seats for elevator attendants.

MECHANICAL TRANSMISSION

23 FRICTION CLUTCH — West End Machine Shop, 1402 Brown St, Wilmington, Del. 8-page booklet gives construction of Cleveland friction clutches. Tables of dimensions are included.

24 WORM GEAR SPEED REDUCER —Cleveland Worm & Gear Co, 2345 E 80th St, Cleveland 4, Ohio. 8-page bulletin presents typical installations of Speedaire, a new worm gear speed reducer.

METERS AND INSTRUMENTS, MECHANICAL

25 HIGH-PRESSURE GAGES—Klingerit, Inc, 16 Hudson St, New York, N. Y. 22-page booklet presents Strahman liquid-level gages for various boilers and tanks.

26 METER AND INSTRUMENT LINE —Builders-Providence, Inc, Providence 1, R. I. 12-page bulletin No. E4-400, entitled "Here's How to Save Heating Steam," explains how meters and instruments can save heating steam.

PIPING, FITTINGS, VALVES AND SPECIALTIES

27 SEATLESS PISTON VALVES — Klingerit, Inc, 16 Hudson St, New York, N. Y. 4-page folder covers construction and operation of Strahman seatless piston valves. Specifications are included.

28 FITTINGS—Stanley G Flagg & Co, Philadelphia 3, Pa. 134-page catalog No. 49 describes comprehensive line of Flagg fittings. Photos and tables are given.

WELDING

29 ARC-WELDING ELECTRODES — Dept WB, Ampco Metal, Inc, 1745 S 38th St, Milwaukee 4, Wis. 10-page booklet gives specifications for copper and copper-alloy metal arc-welding electrodes.

30 ARC WELDING—Hobart Brothers Co, Box DM-526, Troy, Ohio. Folder presents applications of the new Hobart 150-amp welder. Photos are included.

OTHER EQUIPMENT

31 COMPANY HISTORY — National Supply Co, Grant Bldg, Pittsburgh, Pa. 42-page booklet, entitled "The Story of The National Supply Co," covers the founding, growth and operation of this company. It also tells about the petroleum industry that the company serves.

32 COPPER ALLOYS — American Brass Co, Waterbury 88, Conn. 88-page booklet No. B-24, second edition, is divided into two sections. First part gives Anaconda's most generally used alloys, together with all applicable specifications. Second part lists specifications in numerical order with a brief description of materials covered as to grade, type, temper, anneal, etc.

33 THERMOCOUPLE AND PYROMETER ACCESSORIES—Bristol Co, Waterbury 91, Conn. 56-page bulletin No. P1188 contains detailed information on thermocouples, protection tubes and other pyrometer accessories.

34 TURBINE-DRIVEN PUMPS — J S Coffin, Jr, Co, 336 S Dean St, Englewood, N. J. 4-page bulletin "S" describes Types CC and CG high-speed, single-stage turbine pumps.

FIRST CLASS
PERMIT No. 64
(Sec. 510, P.L.&R.)
NEW YORK, N.Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

4c. Postage Will Be Paid by—

POWER

330 West 42nd Street

New York 18, N. Y.

FIRST CLASS
PERMIT No. 64
(Sec. 510, P.L.&R.)
NEW YORK, N.Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

4c. Postage Will Be Paid by—

POWER

330 West 42nd Street

New York 18, N. Y.

A FITTING LESSON

FORGED FITTINGS LAST

Right Professor. ***THE MAJOR COST OF A FITTING IS THE COST OF ITS REPLACEMENT.*** And the life of one *forged* steel fitting is many times greater than that of any other fitting. That's why W-S *forged* steel fittings cost less in the long run, for any industrial service.

If someone in the class asks why, show him photomicrographs of etched forged steel sections. He'll see compact metal structure which resists vibration-fatigue and corrosion. He'll see uniform grain, free of cracks and pockets.

Tell him, too, they're smaller and lighter, size for size and service for service, than most cast types having only a fraction of their pressure rating.

Available? PDQ from W-S distributors in all principal cities.

WATSON-STILLMAN

ROSELLE, NEW JERSEY

Designers and Manufacturers of Forged Steel Fittings, Valves, Wire Rope Shears, Hand Pumps, Jacks, Pipe Benders and Hydraulic Equipment

ESTABLISHED 1848

CARBON STEEL
Low Sulphur, Low Phosphor
High Tensile, High Weldability

ALLOYS
Stainless types 304—316—347
Chrome Moly—Carbon Moly—
Chrome Carbon Moly—Monel
Special alloys for Low Temperatures

SOLD THROUGH LEADING DISTRIBUTORS

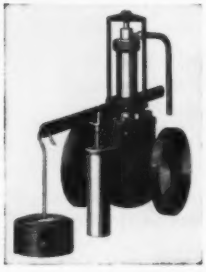
PRESSURE REGULATORS

No. 13

(Left) Here is everything you need for good pressure regulation on small steam, air, or gas-operated units, compact, self-contained; built-in strainer. Parts accessible without disturbing piping. Tight closing, non-sticking single seat valve. Sizes ¾" to 2". For pressure to 250 p.s.i.; reduced pressures from 1 to 100 p.s.i.

No. 14

(Right) A direct connected, spring loaded pressure reducing valve designed for general industrial service on steam, air, gas, water, or oil. Features parabolic balanced disc construction with full port area. Immune to high pressure fluctuations. Control pressure to diaphragm chamber from reduced pressure line. Sizes ½" to 14". Screwed or flanged connections. Bronze, monel, or stainless steel trim. For pressures to 400 p.s.i.; any reduced pressure up to 200 p.s.i.



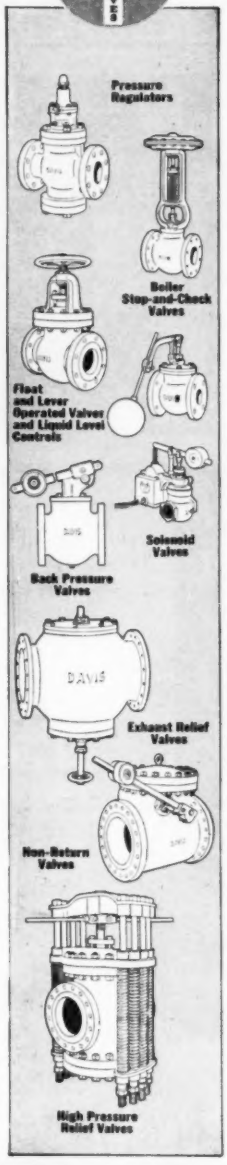
No. 2

(Left) Preferred by many engineers for smooth, dependable regulation of steam, air, or water pressure. Double seated, balanced, piston disc is unaffected by high pressure fluctuations. Counterweight and external oil dashpot make for close, accurate control on variable loads. For initial pressures to 600 p.s.i. and reduced pressures from 2 to 150 p.s.i. Sizes from ½" to 14".

The Davis Line of Pressure Regulators Is Complete!

• 18 different types to choose from; standard sizes up to 24" and for pressures up to 500 p.s.i. Davis recommendations are not biased by any favored types. As the job dictates, you are free to choose between direct or pilot control . . . spring or weight loading . . . piston or diaphragm action. You have your choice of the degree of the sensitivity needed for the job—you don't have to pay for more than you need. Ask for a copy of Davis Bulletin No. 100A. For recommendations, send complete information on your job.

DAVIS VALVES



DAVIS REGULATOR CO.

Representatives in All Principal Cities

2540 S. WASHTENAW AVE., CHICAGO 8, ILL.

Power News

(*Continued from page* 154)

master, the other two acting as followers. Each regulator consists of movable electrodes connected mechanically to a hoist mechanism and electrically through an electrolytic salt solution to form a "Y" and neutral circuit external to the motors. Equal values of resistance can be placed in this circuit for each phase by moving the electrodes nearer together or farther apart. This positioning is done by a GE reversible dc motor on each regulator. Amplidynes furnish the power and control for these small motors.

Atomic Reactors For Power Generation

The Atomic Energy Commission has announced plans beginning July 1 for channeling more than $120,000,000 into reactors, the Atomic piles that produce fissionable materials and nuclear energy. This amounts roughly to twice the money spent in 1948 for reactors.

These reactors are to be developed for (1) propelling ships, submarines and aircraft (2) producing electric energy. Dr Lawrence B Hafstad, Johns Hopkins physicist, has been appointed first director of this development.

Standard Test Code for Fans

Under the sponsorship of the National Association of Fan Manufacturers and the American Society of Heating and Ventilating Engineers with the cooperation of the American Society of Mechanical Engineers a "Standard Test Code for Centrifugal and Axial Fans" was developed and promulgated.

An identifying seal and label entitled "Certified Ratings" has been adopted to enable the buying public to recognize a fan tested and rated in accordance with the Code.

West Penn Power Co has started operations at its new $28,000,000 Mitchell Power Station at Courtney, Pa. near Monongahela. At present only one boiler and one 80,000-kw turbine are in service but a second boiler unit will go on the line in the very early future. A second 80,000-kw turbine generator will be added during 1949.

City of Ames, Iowa has recently awarded contracts for improvements to equipment of the municipal light and power plant. Contracts cover conveyors, equipment for two substations, generator and auxiliary equipment.

To everyone about to order unit heaters, Modine says,

"Look before you buy!"

Design and Mechanical Patents Pending

YES, look before you buy.. and you'll buy Modine!

It's easy to see the difference between Modine unit heaters and all other makes. One look will show you Modine is the leader — the only unit heater which gives you ALL these important features. Modern Beauty. All-Copper Coils. Peak Performance. Easy Installation. Smooth Operation. What's more, you can choose from 3 types and 47 capacities to meet your specific heat, air delivery, height and location needs.

When you look before you buy, you'll see why Modine leads the field. Call your Modine Representative for further details. He's listed in the "Where-to-Buy-It" section of your phone book. Or write direct. Modine Mfg. Co., 1512 Dekoven Avenue, Racine, Wis.

Send for the Modine Unit Heater Catalog Today!

MODINE MAKES THIS SPECIAL OFFER

Get the facts *RIGHT ON YOUR DESK.* Call your Modine Representative today to show you an actual Modine Unit Heater . . . to explain its features in detail. You'll like its attractive appearance, sound engineering, rugged construction. Examine Modine — compare it with other unit heaters before you make your decision.

Look at Modine Suspension!

See how this patented feature eliminates hanger-rods . . . speeds installation . . . lets you direct heat where you want it. Find out how it cuts installation charges up to $10 per heater.

Look at Modine Beauty!

Check Modine's clean, simple lines, beige-gray color, sparkling chrome trim. See how this attractive Modine appearance combines with quality Modine performance to give you the finest in unit heating today.

U-1002-ar

Modine UNIT HEATERS

The New

ROTOJET

Gives you the

POWER

to clean tubes

FASTER

You won't believe any tube cleaner can pack such tremendous power, until you try the new ROTOJET. It removes scale so much faster that it usually pays for itself in one cleaning. Models available for practically any size straight and curved tubes. Send for ROTOJET Bulletin.

THE SECRET

ROTOJET Motor has only two moving parts, a shaft and a paddle. Positive contact between paddle and Rotocentric (egg-shape) bore cylinder prevents stalling at low speeds. No leakage. Delivers maximum power for air used.

S-530 ROTOJET Air-driven Motor with swing-frame head for 3¼–3-13/16" I.D. straight tubes.

ELLIOTT COMPANY-ROTO DIVISION

153 Sussex Avenue **Newark 1, N. J.**

Synthetic Fuel Research Advances

Radical new process improvements now under development in the synthetic liquid fuel laboratories of the Bureau of Mines at Bruceton, Pa. offer high promise of oil and gasoline from coal.

Dr H H Storch, chief of the laboratories, said research activities are centered on (1) fundamental improvement in the gas-synthesis or Fischer-Tropsch process (2) basically new approach to the direct hydrogenation of Bergius-IG Farben process.

Because the synthesis gas—a mixture of carbon monoxide and hydrogen—constitutes 60 to 70% of the cost of liquid fuel from the Fischer-Tropsch process, efforts are being made toward converting at a high efficiency. There are two methods now being followed: the internally cooled, fixed catalyst bed and the oil-catalyst slurry. The first yields 30% more oil than the widely known fluidized-iron catalyst approach and the second—the oil-catalyst slurry—shows even greater promise.

With the hydrogenation method the Bureau of Mines is attempting to reduce costs in the major items of hydrogen, about 50% the cost of the liquid fuel, and capital charge on investment and maintenance equipment.

Midwest Power Show Rescheduled

The Midwest Power and Engineering Exposition has been reinstated. An announcement made by George Pfisterer, 308 W Washington St, Chicago 6, sets the date for the 9th Show as Nov 11-16 at the Navy Pier, Chicago. The shows are planned hereafter for the odd years, thus alternating with the Power Show in New York held on the even years.

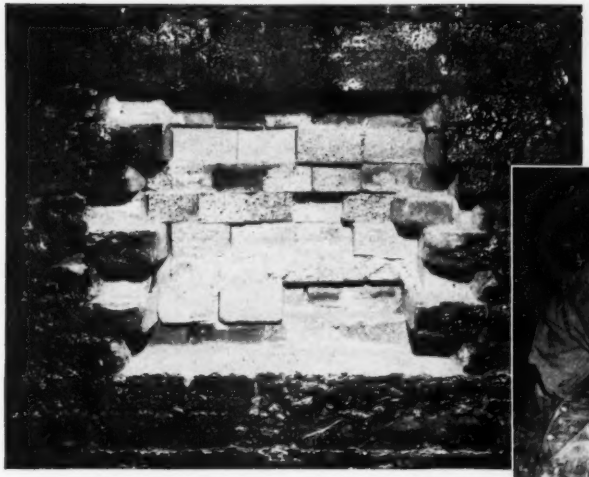
The theme of the show is generation, distribution, utilization and maintenance equipment as well as engineering services. The announcement further states there will be power symposiums held simultaneously in nearby hotels.

Water Softener Association Planned

Preliminary steps have been taken to form a national association of manufacturers of water-softening equipment. A meeting at the Palmer House, Chicago, with 110 representatives of 48 manufacturers elected a committee to draw up a constitution and bylaws as well as suggest a name.

The committee consists of: Charles E Russell, Elgin Softener Corp, chairman; Harold S Werhane, Culligan Zeolite Co, R B Baird, The Duro Co, Herbert Wolcott, Wolcott Water Softeners; Earl C Reynolds, Reynolds-Shaffer Co, Detroit, Mich.

While the emphasis will be on activities of primary interest to manufacturers of domestic water-softening equipment, it is expected that the association will also serve manufacturers of industrial water softeners.



Section of a furnace wall, with damaged brick removed, ready for repair.

Building the patch with Harbison-Walker Plastic Fire Brick. Slabs are ready-cut to convenient size and shape for pounding into place.

HARBISON-WALKER

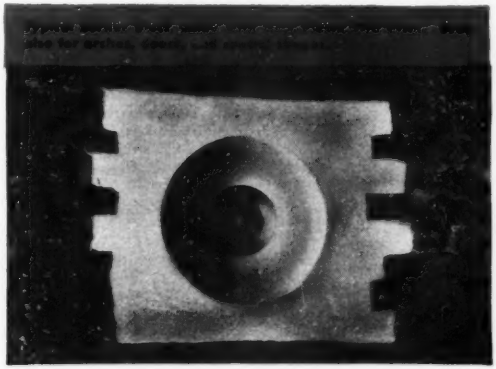
Standard and Super

PLASTIC FIRE BRICK

for repairs, burner ports, irregular shapes, arches, linings

A uniform, moldable mixture of high grade refractory materials, H-W Plastic Fire Brick provides an easy, practical means of repairing furnace walls, and of making burner blocks, arches, door linings and special shapes. Monolithic linings also can be readily made of H-W Plastic Fire Brick, with ordinary tools and without special experience. Comes in 3-inch slabs, ready to use, Standard and Super grades.

Write for descriptive bulletin giving complete details and method of installing.



Harbison-Walker Refractories Company

AND SUBSIDIARIES
OFFICES IN PRINCIPAL CITIES

WORLD'S LARGEST PRODUCERS OF REFRACTORIES

GENERAL OFFICES
PITTSBURGH 22, PA.

TRADE MARK
REG. U.S. PAT. OFF.

NUGENT large-capacity filters

. . . for full-flow filtering clean *all* the oil in circulation every cycle—no *by-passing*

Nugent bag-type lube and fuel oil filters with expendable bags have 20 times more filtering area than other filters of comparable size. Using a Nugent filter, you'll be able to clean more oil per hour, with fewer changes of filter elements. This is particularly important in full-flow systems, where all the oil in circulation each cycle is being cleaned.

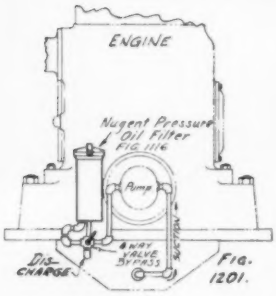


Fig. 1201 shows a Nugent full-flow filtering system. Note that the oil is handled by the engine oil pump — no other pump is needed. Filtering systems of this kind are ready for power equipment of any size. Ask a Nugent engineer to give you full details.

The cutaway view at the right shows the tremendous filtering surface of a single bag-type pressure filter. The bag, designed to be used and discarded, is made of a closely woven lintless material which removes particles as small as a few microns and delivers oil 99.8 per cent clean. This type of filter is ideal for filtering all the lube oil in circulation every cycle before the oil goes to the bearings, thereby removing the dirt as soon as it gets in the oil, and retarding the formation of sludge and acidity. The dirt-filled bags are easily removed without tools, and are inexpensively replaced.

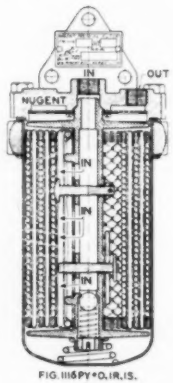


FIG. 1115PY•O.I.R.IS.

There's a bulletin giving complete information on Nugent bag-type filters. Write for your copy today.

NUGENT TRADE MARK

Wm. W. Nugent & Co., Inc.
402 N. Hermitage Ave. CHICAGO 22, ILLINOIS

OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS

Established 1897

Representatives in Boston • Cincinnati • Detroit • Houston • La Junta, Colo. • Los Angeles Minneapolis • New Orleans • New York • Philadelphia • Portland, Ore. • San Francisco Seattle • St. Louis • Tulsa • Representatives in Canada: Montreal • Toronto • Vancouver

Westinghouse Reduces Apparatus Price Ceilings

Westinghouse Electric Corp has announced a reduction from 20 to 10% in ceiling on adjustable prices of apparatus lines. According to a statement by J H Jewell, apparatus sales manager for the company, this is the result of much lower backlogs on most lines.

Reduction in ceiling applies to all apparatus with the exception of waterwheel generators, frequency changers, synchronous condensers, stokers and power transformers above 15,000 kva. Because of continuing higher manufacturing costs, price increases are also announced at this time on certain apparatus lines: steam condensers, feedwater heaters and evaporators —5%; ac motors over 50 hp and integral hp dc motors—about 5%; turbine-generators, 20,000 kw and above—10%.

Other lines are being analyzed and Westinghouse hopes that additional price increases will not be necessary at this time. Price adjustments and ceiling reductions bring about a closer approach to a firm policy enabling purchasers to plan more definitely.

Two Utility Companies Order New Gas Turbines

Three new gas turbine-generator power plants, expected to be the most powerful and most efficient units built in this country, have been ordered from General Electric by two electric utility companies. Two of the 5000-kw sets are being built for Public Service Co of Oklahoma; another will go to Bangor-Hydro-Electric Co of Maine.

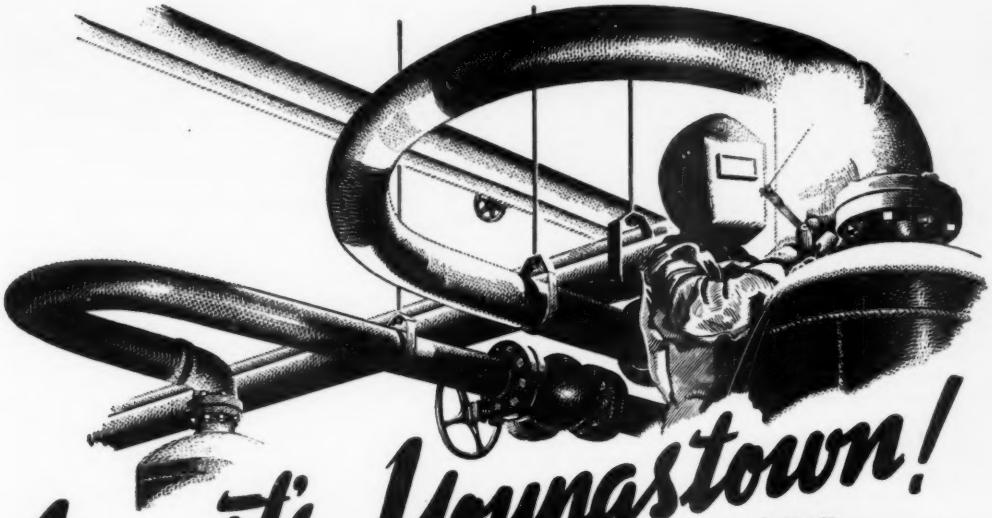
The first unit will be ready for delivery in the late summer of 1949 after exhaustive factory tests have been completed. The first of their type, their cycle efficiency is expected to equal that of comparable-sized steam-generating plants.

Natural gas will be used for fuel for the Oklahoma units while bunker fuel oil will be used in the unit for Maine. Purchase of the gas-turbine power plant represents a new step for Bangor Hydro as that system has always been 100% hydroelectric power in the past. This will be their first fuel-fired generating station.

In both the natural gas and bunker fuel oil installations, the units will convert energy from fuel directly into electric power without use of intermediate means, such as boilers and condensers. Each unit will consist of two gas turbines, one driving a low-pressure air compressor, the other driving a high-pressure compressor. The high-pressure turbine will drive a conventional steam turbine-type generator through reduction gears.

The new design differs in two ways from the simple cycle type previously built. Intercoolers will be used between the two stages of compression to reduce power needs of the compressors and waste heat from exhaust will be used in a regenerator to increase efficiency. Simple cycle units use neither intercoolers nor regenerators.

While the power plants are rated 5000 kw, they will be equipped with oversize,



Yes, it's Youngstown!

Dependable Steel Pipe ...Easy to Install

THROUGH the years, the guiding principle at Youngstown has been to make quality steel pipe which is well suited to serve the needs of plumbing and heating contractors and their customers. That's why Youngstown Pipe bends accurately, cuts readily, threads surely, welds easily--properties designed into the product for efficient fabrication, installation and long, satisfactory service.

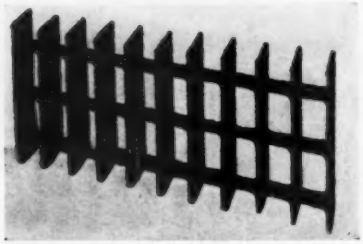
Youngstown
STEEL PIPE

THE YOUNGSTOWN SHEET AND TUBE COMPANY General Offices Youngstown 1, Ohio

Manufacturers of Carbon, Alloy and Yoloy Steel Export Office-500 Fifth Avenue, New York

PIPE AND TUBULAR PRODUCTS - CONDUIT - BARS - RODS - COLD FINISHED CARBON AND ALLOY BARS - SHEETS - PLATES - WIRE - ELECTROLYTIC TIN PLATE - COKE TIN PLATE - RAILROAD TRACK SPIKES.

FOR TWELVE YEARS



. . . under extreme conditions

The section illustrated was cut from a panel of Hendrick Mitco that for twelve years was in an open yard between buildings in an industrial plant. It not only was exposed to rain, snow and atmospheric corrosion, but was in a drainage area and actually under water much of the time.

The joints show the least corrosion and have no crevices or cracks, although the side surfaces of the bars have been roughened and practically eaten away.

Write for detailed information on Hendrick Mitco Grating, Open Steel Flooring, Shut-Site Treads, and Amorgrids.

SEE OUR CATALOG IN SWEET'S

HENDRICK

Manufacturing Company

Perforated Metals
Perforated Metal Screens
Architectural Grilles
Mitco Open Steel Flooring,
"Shur-Site" Treads and
Armorgrids

46 DUNDAFF STREET, CARBONDALE, PENNA.

Sales Offices In Principal Cities

CRYER TRAPS *are high in dependability and low in maintenance*

because:

- . . . they neither stick nor bind
- . . . they are self-cleaning
- . . . all air is discharged quickly before condensate without regard to temperature
- . . . they are positive acting . . . a free turning ball insuring correct seating
- . . . premature raising of bucket by slugs of condensate prevented by baffle plate
- . . . they are easy to install, service and clean
- . . . all parts are amply designed and of long-lived corrosion-resisting materials

Cryer also makes: Thermostatic Radiator Traps; all sizes of traps and repair parts for the line formerly known as the J-M Ball Steam Trap; Encor Strainers for steam pressures to 250 lbs. or 400 lbs. pressure cold water, oil or gas.

Sizes ½" to 2½"

A widely used, popular model is the No. 20 Junior ½" Cryer Trap. This size and type is especially recommended for installation in conjunction with unit heaters, laundries, dairies, etc.

DELIVERY FROM STOCK

Available from leading distributors everywhere. Ask for complete details.

CRYER TRAP AND VALVE CO., INC.

366 MADISON AVE. NEW YORK 17, N. Y.

Manufacturers of steam specialties for over forty years

6000-kw generators to permit increased loading during periods of low ambient temperatures. Total water requirements will be reduced about 90% because of elimination of boilers and condensers required in steam-generating plants.

Corrosion Control In Government Plants

The first report on a series of studies of chemical treatment of boiler water to control corrosion in steam-heating systems—a project that already is saving the Government about $30,000 a year—was released recently by Bureau of Mines. Although the research was conducted primarily to save money for the Government, it is believed that the results will be equally helpful to operators of hospitals, hotels, apartment houses, office buildings and other establishments that require extensive heating installations.

Tests described in the report were conducted jointly by the Bureau and Army Engineers at an army post where the central heating plant served an area about one third of a mile square. Three alkaline chemical compounds, called amines, were tested to determine their relative effectiveness in preventing corrosion in the condensate-return lines. The compounds tested are known as cyclohexylamine, morpholine and benzylamine.

The report describes steam system of the post, together with testing equipment and sampling and analytical methods used. It presents and discusses data gathered during six test runs. Recommendations regarding the volatility and alkalinity of amines most desirable under varying conditions are given. Diagrams, photographs and tables illustrate the text. Technical Paper 714, *Amine Volatility and Alkalinity in Relation to Corrosion Control in Steam-Heating Systems*, by A A Berk, supervising chemist, Boiler Water Research Section, Fuels Utilization Branch, Bureau Fuels and Explosives Div, and J Nigon, former Bureau chemist, may be obtained from *Superintendent of Documents, Government Printing Office, Washington 25, D. C.*

A 72-page directory, entitled 1949 *Directory of Occupational Safety Posters,* prepared by National Safety Council, contains 744 illustrations of two, three and four color posters, classified under 15 sections. A convenient index locates posters quickly on specific accident hazards. Posters range in size from 8½x11½ in. to 10x12 ft. Price per copy is 50¢ from *National Safety Council, 20 N Wacker Dr, Chicago 6, Ill.*

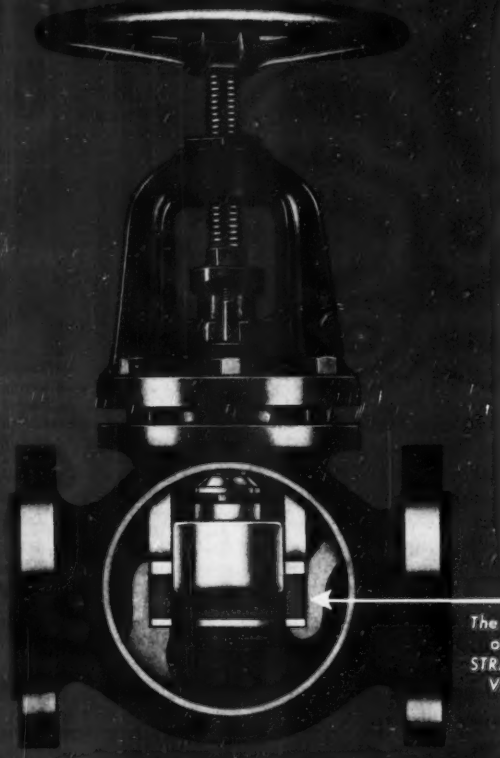
Corn Belt Power Co-operative, Humboldt, Iowa has awarded the contract for the superstructure of its new power-plant building to Jans Oleson and Sons Construction Co, Waterloo, Iowa; Stanley Engineering Co, Muscatine, Iowa are the consultants.

Central States Electric Co is completing a generating station, consisting of two 1650-hp diesel electric generators at Belmond, Iowa. A similar station in Eldora, Iowa has just gone into service.

Strahman

SEATLESS PISTON VALVES

A RADICAL DEPARTURE IN CLOSURE PRINCIPLE



Force is never necessary to close a Strahman Valve.

The long sealing surface gives positive shut off.

No metal to metal contact is involved — hence no expansion or contraction problems.

Positive closure assures prolonged life of equipment which the valves control.

Suitable for low and high temperature range of minus 125° F. to plus 750° F.

The Ring (usually made of laminated sheets of compressed asbestos) is available in materials suitable for hard-to-hold liquids or gases.

The ring may be further compressed against the piston by a take-up on the bonnet, while the valve is in service. The ring is easily replaced when necessary.

The HEART of the STRAHMAN VALVE

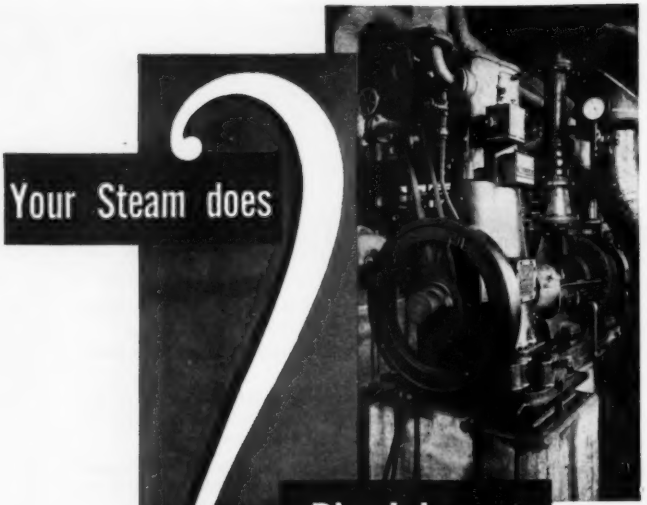
A MOST POSITIVE CLOSURE PRINCIPLE

The pressure seal [illegible] entering the ring [partly closed], just as a cork seals a bottle.

Made in Cast Bronze, Steel and Iron. Screw ⅛" to 2½" Globe and Angle. Flange 1" to 10" Globe and 2" to 6" Angle.

Complete catalogue will be sent on request

KLINGERIT, INC., 18 HUDSON STREET, NEW YORK 13, U. S. A.



Your Steam does

2

Big Jobs....

When a Troy-Engberg Engine is Used

With proper plant heat balance your steam may do two big jobs. If you generate steam for processing or heating a Troy-Engberg Steam Engine can produce By-Product Power at a very low cost. The same steam then yields power as well as heat units!

It's the simplest story in the plant. Steam is first passed through the engine — driving pumps, stokers, compressors, blowers or generators. Then the exhaust, with most of the original heat units still intact, is used for processing or heating. And for dependability nothing beats the standard counterflow steam engine . . . no interruptions from power failure.

TROY ENGINE & MACHINE COMPANY
(Established 1870)
2500 Railroad Avenue **Troy, Pennsylvania**

TROY-ENGBERG
STEAM ENGINES · GENERATING SETS · GENERATORS

APPOINTMENTS

Taylor Forge & Pipe Works, Chicago, announces resignation of James A Greer as advertising and sales promotion manager.

William R Moore is elected a director of **Norton Co,** Worcester, Mass. He is currently a vice-president.

Black, Sivalls & Bryson Inc, Kansas City, Mo., has named General Harlan L Mumma, U S A, retired, as world export manager of the company. General Mumma's headquarters will be at 30 Rockefeller Plaza, New York City. Celia Rubin has been chosen to head the clerical staff in the office. Earl Ruth has been transferred from Kansas City executive offices to General Mumma's staff as consulting engineer.

Robert F Edwards has been appointed section engineer in charge of synchronous motor and vertical generator section of **Elliott Co's** Ridgway div, Ridgway, Pa.

Link-Belt Co promotes R E Whinrey to assistant general manager of Link-Belt Dodge plant, Indianapolis. L C Heinlein succeeds Whinrey as superintendent.

Jesse W Eakins Co, 3105 East Grand Blvd, Detroit 2, Mich., represents **Aldrich Pump Co** in Detroit area.

Syntron Co, Homer City, Pa., announces establishment of several district sales offices and promotions of sales personnel as follows: W C Leasure is district sales manager in charge of new sales office in Houston, Texas. Nelson C DeVilling is district sales manager of new sales office in Dallas, Texas. James B Barth replaces DeVilling in Pittsburgh sales office. Dick McHale is now district sales manager of Los Angeles office and is succeeded by G R Stocum in Chicago sales office. Ernest K Hood is district sales manager and D E Nugent takes over power tools sales of new sales office in Kansas City, Mo. R K Bentzien is added to Milwaukee sales office staff, taking charge of power tool and paper jogger sales.

Appointment of Ehret & Kinsey, 327 S LaSalle, Chicago, as sales engineers is announced by **American Flexible Coupling Co,** Erie, Pa.

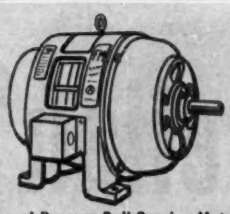
Joseph R Parsons joins research dept of **Harbison-Walker Refractories Co** as a research engineer at its Hays Laboratory, Pittsburgh, Pa.

Worthington Pump & Machinery Corp announces that sales of welding positioners and turning rolls manufactured at the firm's Dunellen, N. J. works will be supervised by Frank J Whelan, vice-president, with headquarters at Harrison, N. J.

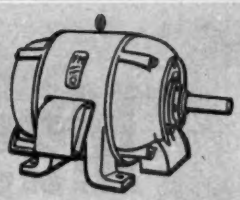
Norman C Michels is manager of operations of **Laclede-Christy Co,** St Louis, and its subsidiaries. Michels reports directly to Donald N Watkins, president and general manager.

Power-plant control-equipment div of **Swartwout Co,** Cleveland, has established an office at 1817 E Allegheny Ave, Phila-

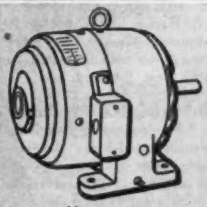
Vertical Motors



General-Purpose Ball-Bearing Motors

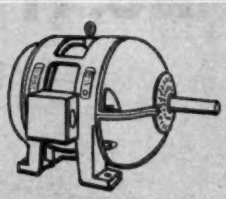


Splashproof Motors



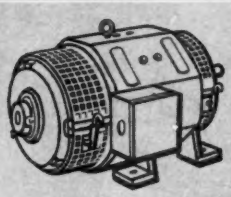
Motorgears

Multi-Speed Squirrel-Cage Motors



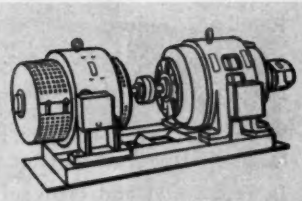
Totally Enclosed Fan Cooled

when it comes to Motors...



D.C. Motors

You stand to gain much in dealing with your Fairbanks-Morse Branch or Dealer as the single source for *all* your electric motor requirements. Not the least are the benefits of undivided responsibility, unprejudiced advice and application assistance. For your copy of the handy "Pocket Panorama" which illustrates the complete line . . . write Fairbanks, Morse & Co., Chicago 5, Illinois.

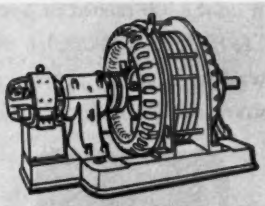


Motor Generator Sets

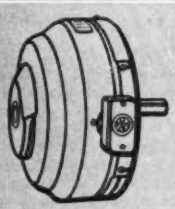
FAIRBANKS-MORSE

A name worth remembering

DIESEL LOCOMOTIVES · DIESEL ENGINES · STOKERS · SCALES · MOTORS · GENERATORS
RAILROAD MOTOR CARS and STANDPIPES · PUMPS · FARM EQUIPMENT · MAGNETOS

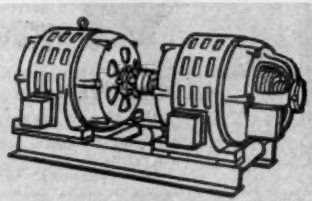


High-Speed A.C. Generators



Axial Air Gap Motors

Low-Speed A.C. Generators



Frequency Changer

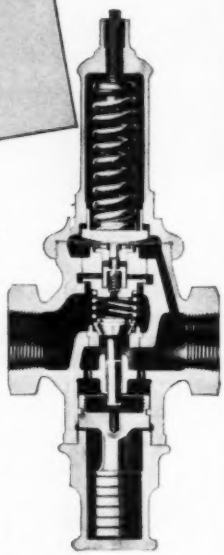
Masoneilan

NO. 11 REGULATORS

Cut Your

Masoneilan No. 11 Pressure Regulators reduce waste by holding pressures where you want them. Their tough, rugged construction assures dependable operation in all types of service . . . gives long-lived performance for years on end. In fact, you'll find many of these No. 11 Regulators still performing accurately with an on-the-job record of over 20 years.

Investigate Masoneilan No. 11 Pressure Regulators, today. They will give you accurate service and cut maintenance costs.



No. 11
Pressure Regulator

USE A MASONEILAN STRAINER

in all water, steam or air lines to protect valves, traps, etc., from scale, dirt or other foreign matter. These strainers are precision-built for long reliable service. They cost no more than others.

MASON-NEILAN REGULATOR COMPANY

1186 ADAMS STREET, BOSTON 24, MASS., U. S. A.

New York, Chicago, St. Louis, Philadelphia, Houston, Cincinnati, Buffalo, Pittsburgh, Tulsa, Los Angeles, Cleveland, Atlanta, San Francisco, Mason Regulator Co. of Canada, Ltd., Montreal and Toronto

delphia. R J Jones and R H Frost are in charge. Sales and service activities of ventilator and power-plant equipment div have been separated to give better service in the Philadelphia territory. Wm F Hawk continues to represent the ventilator div at 328 Chestnut St.

Alloy Steel Products Co, Linden, N. J., opens a New York sales office with Richard E Boller Jr as district manager. Associated with Boller are Ralph O Dale, Henry G Harley and Elliot A Baines as sales representatives. The office serves the Metropolitan area including New York State and New England.

Yarnall-Waring Co, Philadelphia, announces following changes in its sales and manufacturing divisions: Joseph Kildare is vice-president in charge of sales, and Frank W Miller is vice-president in charge of manufacturing. Carl Liberg is now at the new district office in Buffalo and C V Peterson is sales representative in the Cleveland district.

Dr William Lee Davidson has been named director of **B F Goodrich Co**'s physical research dept. Also, Jay E Miller has been made western public relations manager. Miller's headquarters are at 5400 E Olympic Blvd, Los Angeles.

Diamond Alkali Co appoints Neil J Braski assistant superintendent of power at its Painesville, Ohio plant.

Joseph T Adams is Midwestern district manager for **Nordberg Mfg Co.** Adams' offices are in Kansas City, Mo.

Watson-Stillman Co names McNevin-Wilson-Dalldorf, Inc, 55 W 42 St, New York City, as its new advertising agency.

Gordon Davisson joins staff of **Young Radiator Co,** Racine, Wis., as an engineering representative. He will devote his time primarily to field work and the service of Young customers.

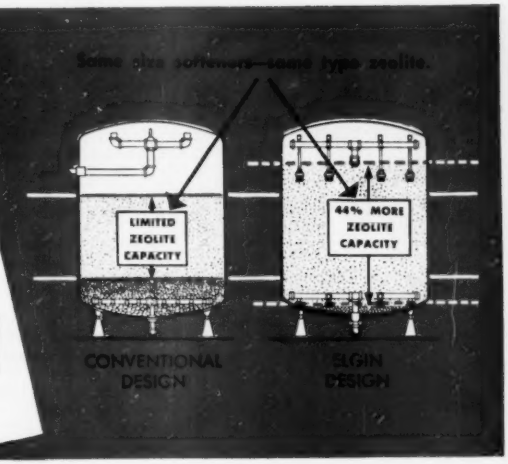
Monsanto Chemical Co opens an export sales dept in San Francisco with Paul C McMillan as manager. The office is situated with Monsanto's domestic sales organization at 111 Sutter St. Also, J P Bufe replaces H A Dilliard, who resigned, as head of the power div at the company's plant in Monsanto, Ill.

E L Klinger directs sales of **Wickwire** rope in the mid-continent area including Houston, Abilene, Texas and Tulsa, Okla. Klinger is located at Houston, Texas.

Robert L Sommerville becomes assistant general sales manager of **Electric Storage Battery Co.**

De Laval Steam Turbine Co, Trenton, N. J., announces following executive changes: Henry W Johnson is retiring as vice-president in charge of manufacturing, but will continue as director and a member of executive committee. C Richard Waller is named vice-president and director for engineering and H G Bauer is vice-president and executive engineer. J P

Still the Biggest Water Softener Development in Recent Years!



Zeolite is a remarkable mineral — an ideal means of softening water — *but* . . . it remained for Elgin to introduce a method of making the zeolite softener get down to business and really do things in a big way.

This development — the Elgin "Double-Check" Softener — is still the biggest water softener development in recent years!

Like all basic changes its story is simple. By preventing the escape of zeolite under all conditions, the Elgin "Double-Check" manifold permits putting more zeolite in a softener of given size. Since it's the zeolite that does the softening, this means more gallons of soft water per regeneration.

But notice, also, that by preventing the escape of zeolite a high backwash rate can be used which means better opening up and regrading of the zeolite bed, better regeneration by the brine, more efficient use of the zeolite throughout the service period.

That is why hundreds of users of the Elgin "Double-Check" report *that it gives up to 44% more soft water per regeneration than any other softener of equal size.* Yes, 44% more soft water from a softener of the *same size* containing the *same* type of zeolite. To you this means either added capacity from the same size softener, or the same capacity from a smaller one . . . always with a real saving in original investment, operating, and maintenance costs. Ask for Bulletin 607 containing eye-opening details.

ELGIN SOFTENER CORP., 130 North Grove Ave., Elgin, Ill.

ELGIN *"Double Check"* METHOD

Note the ingenious upper and lower manifolds containing check valves which prevent escape of zeolite, permit deeper bed, better regeneration and assure better distribution of water with higher efficiency

Extra gallons of soft water from your present softener!

This Elgin development is adaptable to all makes of existing softeners. Let us show you how we can step up the output of your present softener (as much as 3 to 10 times with our new high capacity synthetic and resinous zeolites) . . . just as we have done it in hundreds of plants.

ELGIN
ECONOMICAL WATER CONDITIONING

NOW AVAILABLE THROUGH ELGIN—

ILLCO-WAY DE-IONIZERS

ILLCO-WAY

. . . for de-minerization of water

By joining the services and products of the Illinois Water Treatment Co. with Elgin Softener Corp., the already wide range of Elgin services is further broadened to include Illco-Way De-alkalizers for boiler makeup, De-mineralizers and special Ion-exchangers. Ask for data.

SOFTENERS • CHEMICAL TREATMENT • FILTERS • ILLCO-WAY DE-IONIZERS

Check Your Paint-Stripping Problem HERE

- ☐ How can we peel off baked-on primer coats without resorting to expensive thinners and solvents?
- ☐ Do you have a setup for removing toluene-thinned, asphalt-based paints from underground transformers without spending years at it?
- ☐ We've had a pack of armature coils out in the shop for 18 months, waiting for an economical way to strip insulating varnish . . . what stripper have you got?
- ☐ Other headaches:

NAME .....

ADDRESS .....

COMPANY .....

Power-plant paint-stripping can be done easily and quickly if the correct stripping compound is selected — then *applied* correctly. Take transformer stripping, for example. Your nearby Oakite Technical Service Representative can show you a number of job-proved methods . . . including hot flow-on, cold-spray, steam-gun and tank-immersion. He'll help you select the Oakite method best adapted to your need . . . help you save time and money on the job.

Tear out the coupon above and let us have notes on your paint-stripping problem (whatever it is). We'll ask the Oakite Man near you to talk it over . . . or if you want to think about Oakite paint-stripping procedures some more, write for a free copy of the new Oakite Power Plant Digest. No obligation.

OAKITE PRODUCTS, INC.
23 Thames St., N. Y. 6, N. Y.

OAKITE

OAKITE 40 ANNIVERSARY YEAR

SPECIALIZED INDUSTRIAL CLEANING MATERIALS • METHODS • SERVICE

Technical Service Representatives Located in Principal Cities of United States and Canada

Stewart, manager, commercial sales div, is now a vice-president. W A Reynolds assumes responsibility for development and merchandising of new small products in addition to his present position. W A Neumann Jr is controller.

Lima-Hamilton Corp appoints Eugene C Schum diesel engine sales manager of Hamilton division. Schum makes his headquarters in Hamilton, Ohio.

Alexander B Zeitlin has been elected president and a member of board of directors of **Hill Diesel Engine Corp,** Lansing, Mich.

Allis-Chalmers promotes J H Burrus to manager of the company's Portland district office to succeed F V Sams, who has retired. In the electrical dept, H V Nye is named consulting engineer for switchgear section. T G A Sillers succeeds Nye as engineer-in-charge of switchgear design.

Superior Coal, Coke & Fuel Oil Co, 919 Wells St, Fort Wayne, Ind., is now distributor of **Dravo** counterflo heaters in northeastern Indiana.

Raybestos-Manhattan Inc announces establishment of warehouse and office at 314 Occidental Ave, Seattle, Wash., with Russell G Heuman in charge.

Lawrence M Rudbeck represents **S&C Electric Co** as sales engineer for Indiana, western Kentucky, and southern Illinois territory. Rudbeck's headquarters are at 310 Test Bldg, Indianapolis.

Dampney Co of America, Boston, expands territory assigned to its Minneapolis representative, Protective Coating Service, 913 Summer St, N E. Under direction of Ray Ekberg, sales manager, the Dampney agency will extend its sales and application activities to include Minnesota, North Dakota, western Wisconsin, northern Iowa, and eastern South Dakota.

O W Wagner has been elected president of **Belmont Packing & Rubber Co,** Philadelphia, Pa.

Peerless Pump div, Food Machinery & Chemical Corp forms new sales district with offices at 4330 Leavenworth St, Omaha, Nebr. J W L Stone is district manager. His territory includes North and South Dakota, Montana, Minnesota, Nebraska, Kansas, Colorado and portions of Wyoming, Missouri, Wisconsin and Iowa.

Fabricating div of **E B Badger & Sons Co,** complete with plant, buildings, equipment, sales and manufacturing facilities, has become a separate entity, and incorporated under name of Badger Mfg Co, 260 Bent St, Cambridge 41, Mass.

Tube Turns Inc selects Ardun Co, 317 S Detroit Ave, Tulsa, Okla., as its distributor.

General Electric Co has announced several changes in its various departments as follows: Ralph M Darrin has been made

Here's the information you need to equip yourself for a better job

Hundreds of men are using this practical library to reach the top in the power plant field. It brings you a complete education in power plant practice; it packs between the covers of 6 concise volumes a wealth of information on boilers, steam engines, steam turbines, pumps, boiler-feed apparatus, etc. Not only do you get the "how to" of every phase of power plant work, but this library gives you the fundamental principles in back of each phase and tells you "where," "when," and "why" a job should be done in a particular way.

The Library of

POWER PLANT PRACTICE

By TERRELL CROFT

6 volumes, 2477 pages, 2404 illustrations

Here are the results of years of experience with power plant problems . . . an accurate on-the-job guide to getting the **right** answers quickly and with remarkable ease. The Library of POWER PLANT PRACTICE is the one standard reference work in the field . . . the set you can turn to with confidence on any power plant problem.

Covers power plant work inside-and-out

Every important division of power plant practice is explained for you in a clear, easy - to - understand way . . . from the selection of engines to the operation of electrical equipment . . . from a basic, clear explanation of the "stickers" you meet up with in your work to analyses and solutions to the big troublesome problems . . . all plainly worded and explained with clear illustrations. Every page is packed with the kind of information that the power plant man wants and needs in his daily work.

6 powerful self teachers

1. **Steam Boilers**
2. **Steam Engine Principles and Practice**
3. **Practical Heat—Part I**
4. **Practical Heat—Part II**
5. **Steam Turbine Principles and Practices**
6. **Steam Power Plant Auxiliaries and Accessories**

SEND NO MONEY

Examine these books yourself—FREE

With a little spare-time reading you can have the identical knowledge possessed by the highest paid engineers. They make big money because they know Power Plant Practice from A to Z . . . here's your opportunity to join their ranks! You don't have to send one red cent. Return the coupon below and we'll send you all six books for a 10 days' free examination. After 10 days you are free to return the books without obligation . . . or, if you decide to keep them, to pay in easy monthly installments as outlined below.

~~JUST MAIL COUPON~~

McGRAW-HILL BOOK COMPANY, Inc.
330 W. 42nd St., NYC 18

Please send me Croft's LIBRARY OF POWER PLANT PRACTICE, 6 volumes, for 10 days' examination on approval. In 10 days I will remit $3.50 and $3.00 monthly until the total price of $18.50 is paid, or return the books without obligation.*

Name .....

Address .....

City ..... Zone ..... State .....

Company .....

Position P-3-49

*SAVE! We pay postage and packing charges if you send first payment with this coupon. Same return privilege.

WATCHDOG for your liquid systems...

pH and Conductivity Control with the *ElectroniK* Potentiometer

THE pH and conductivity of the liquids and solutions you use in your plant are mighty important. You can control these conditions easily and automatically with the Brown *ElectroniK* Potentiometer . . . the instrument of unmatched speed and extreme accuracy . . . the instrument in which many moving parts have been replaced with vacuum tubes.

You get control that not only reduces production costs but also improves quality and cuts down product rejects. In addition, it reduces maintenance and waste disposal costs. In all cases it writes a record of what has happened—a mighty handy proof of your plant practices.

Catalog 15-12 describes the ElectroniK and its application to the control of pH and conductivity. Write for your copy today.

MINNEAPOLIS-HONEYWELL REGULATOR CO.
BROWN INSTRUMENTS DIVISION
4490 Wayne Ave., Philadelphia 44, Pa.
Offices in principal cities of the United States, Canada and throughout the world

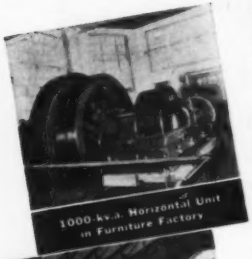
BROWN *Advanced Instrumentation* FOR BETTER PROCESSING
Product of MINNEAPOLIS Honeywell

For Nearly Four Decades

SKINNER "UNIVERSAL UNAFLOW"

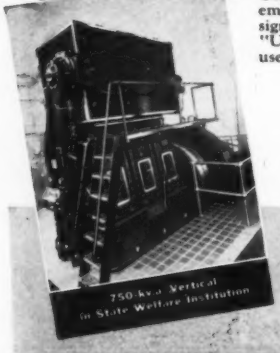
STEAM ENGINES

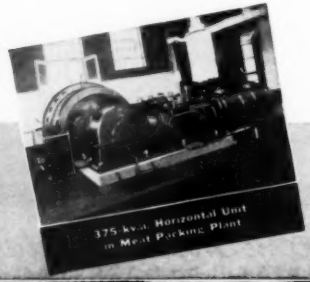
HAVE BEEN MEETING INDUSTRY'S DEMAND FOR DEPENDABLE, ECONOMICAL ELECTRIC POWER


1000-kv.a. Horizontal Unit in Furniture Factory

375-kv.a. Vertical in Penal Institution

138-kv.a. Horizontal Installation in State Teachers College


750-kv.a. Vertical in State Welfare Institution


375-kv.a. Horizontal Unit in Meat Packing Plant

EXPERIENCE

For over three-quarters of a century, doing one thing well—building steam engines. This plant is the largest in the United States devoted exclusively to the building of steam engines, and the Skinner organization has justly acquired the reputation of being steam engine specialists.

THE "UNIVERSAL UNAFLOW"

The "Universal Unaflow" was the first American poppet-valve unaflow engine, and has earned popular recognition as "the most economical steam engine built." More "Universal Unaflow" engines have been built than all other American unaflow engines combined.

Two thousand power users, in industries and institutions of various types, have found it more economical to generate their own electric power with Skinner "Universal Unaflow" Steam Engines than to purchase power from the local utility, or to generate their power with other prime movers.

ADAPTABILITY

Suitable for noncondensing or condensing operation, with automatic change for either condition. Also may be built for constant or variable back pressures; medium or moderately high initial pressures, saturated or superheated steam.

MAINTAINED ECONOMY

Maintained economy is guaranteed, and is due to patented design of the poppet inlet and auxiliary exhaust valves, which are steam-tight after long use and under any variation of steam pressure or temperature. Steam consumption guaranteed subject to test after six months' operation, with final payment withheld until after test.

HORIZONTAL ENGINES

In general use for direct connection to electric generators, refrigeration equipment, compressors, blowers, pumps, etc. Special manual or automatic controls for variable speed and load requirements.

VERTICAL ENGINES

For limited space, or where other conditions make a vertical engine preferable, the stationary "Universal Unaflow" is offered in multi-cylinder vertical type, embodying the same fundamental economy and design features as the horizontal. Multi-cylinder vertical "Universal Unaflow" assemblies also extensively used for variable-speed compressor drive.

For Over 80 Years, Doing One Thing Well: Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

a commercial vice-president assigned to customer relations work in New England territory. John J Huether succeeds Darrin as manager of central station divisions and also continues as manager of transportation div. Apparatus dept has established a separate sales district for Michigan, with headquarters in Detroit. A R Hines has been appointed manager with V J Snyder and C M Dunn as assistant managers of the Michigan district, which includes Detroit, Lansing, Jackson, Grand Rapids, and Saginaw.

Operations of wire and cable divisions of apparatus and construction materials dept of **GE** have been consolidated. Overall responsibility for that portion of wire and cable business formerly assigned to apparatus dept, Schenectady, has been transferred to construction materials dept, Bridgeport, Conn. Services of apparatus dept sales organization have been retained to handle sales of cables to electric utilities. B F Ilsley has been named manager of the expanded wire and cable div and is responsible for all operations including engineering, manufacturing, and sales. Also, Clarence C Walker, general manager of construction materials dept, has been elected a vice-president.

In turbine, generator and gear engineering divisions of **GE** River Works, Lynn, Mass., W W Kuyper is appointed divisions engineer to succeed K M Holt, who is retiring. J J Zrodowski is named designing engineer, and L J Collins replaces E N Twogood as division engineer of gear engineering div. Twogood has retired.

New quarters for Indianapolis **sales office** of **Cutler-Hammer Inc,** are at 644 E Maple Rd. F W Gilchrist manages the office as a branch of the firm's Chicago district office.

Chase Brass & Copper Co elects Wallace C Husted executive vice-president. Husted's headquarters are in Waterbury, Conn.

Claude V Harp Jr joins staff in Houston, Texas office of **Reliance Electric & Engineering Co.** As field sales engineer Harp reports to Frank A Denison, district manager for the company in Houston. Also, R F Kendall becomes credit manager for the firm.

Johns-Manville Corp names Maurice Davier general manager of its Van Cleef div in Chicago. Dr C E Frick becomes plant manager. Frank Hagerty, sales manager reporting to Felix Van Cleef, vice-president in charge of sales, will assume greater responsibility.

New manager of div of municipal and process waters, **Calgon Inc,** Pittsburgh, is John P **Kleber.**

McQuay Inc, Minneapolis, **elects Philip** S Morris, executive vice-president and H Blake Thomas, vice-president in charge of sales.

Babcock & Wilcox Co has named George H Hodges manager of its marine dept. William M Firshing has been transferred

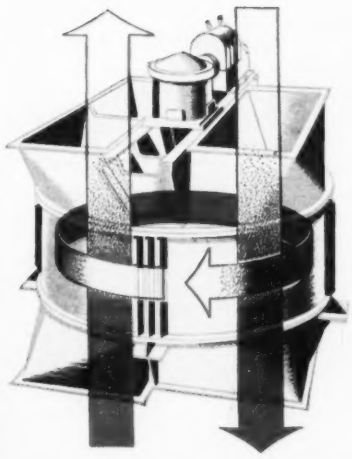
Fact File on Preheat

IN THE LJUNGSTROM, heat is not required to pass *through* the metal and its surface accumulations.

This type of air preheater maintains heat recovery at a *constant level* despite the inevitable surface accumulation of soot and fly ash.

Between cleanings, the surface "as is," acts as an efficient heat storage and transfer medium.

LJUNGSTROM



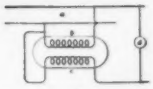
The Ljungstrom Air Preheater is a compact gas-to-air or gas-to-gas heat exchanger, operating on a continuous regenerative counterflow basis. Hundreds of power plants and other special applications confirm its high level of heat recovery and long-term service at low maintenance expense. Write for engineering details to:

THE

AIR PREHEATER CORPORATION

60 EAST 42ND STREET · NEW YORK 17, N. Y.

Plant: Wellsville, N. Y. 381



The new, one volume reference and manual for engineers and electricians

Transformers

THEORY AND CONSTRUCTION

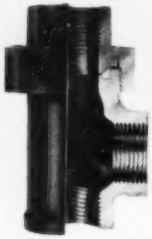
By W. C. SEALEY, Engineer-in-Charge, Transformer Design, Allis-Chalmers Mfg. Co.

● An authoritative presentation of modern transformer theory and practice. Assembled into one place is the basic information on theory and practice used by transformer engineers. Includes specific information which previously has not been available in one volume. Only modern up-to-date material has been used, with non-essentials eliminated. 250 pages, 133 illustrations, 1948 copyright. $3.00

The I. C. S. Electrical Engineer's Handbook

● The pocket-size encyclopedia of information to help you on the job. Contains dozens of useful tables; plus reference material on every phase of electricity, batteries, motors, power plants, wiring, control, heating, measurements, plating, magnetism—everything you can think of. 370 pages, illustrated, 3¾"x5½". Tremendous value for only $1.75.

INTERNATIONAL TEXTBOOK CO.
Scranton 9, P. Pennsylvania



You Pay for Better Performance ... and Get it ... with

Jefferson UNIONS

Better performance is an advantage attained by all Jefferson Unions and is the direct result of their permanent leakproofness assured by the exclusive Recessed Brass Joint. This construction costs more to produce but far less to maintain. The Recessed Brass Seat provides self-seating and free flow through the fitting with seat protected against threaded pipe ends coming in contact with it. Jefferson Unions are made of air-refined malleable iron and every union is air-tested.

The Union Tee shown here is typical of the complete line of Jefferson Specialty Unions. Full details are available through your nearest distributor or from us direct.

JEFFERSON UNION CO.
605 W. 26th St., New York 1, N. Y.
63 Gooding St., Lockport, N. Y.
39 Fletcher Ave., Lexington 73, Mass.

10 REASONS WHY

UNIT TRAPPING IS PRACTICAL

with Nicholson Expansion Steam Traps

For ALL EQUIPMENT USING STEAM or HOT WATER

Below are some typical applications of this widely used Nicholson trap:

Radiators
Separators
Paper Machinery
Pipe Coils
Kettles
Railway Coaches
Dry Kilns
Vulcanizers
Switch Heaters
Laundries
Plastic Molding Presses

1) Low cost makes unit-trapping economical.
2) Easily installed, usually without supports.
3) Easily adjusted for any pressure from 0 to 250 lbs. without change of valve or seat.
4) Valve is adjustable for regulating temperature of condensate.
5) Entirely automatic action.
6) Quiet, continuous discharge.
7) Discharge air as efficiently as water.
8) No air-binding; no freeze-ups.
9) Hardened stainless steel valve and seat.
10) In various overall lengths: 18" to 40".

Catalog 448 or see Sweet's

W. H. NICHOLSON & CO., 125 Oregon St., Wilkes-Barre, Pa.

from that dept to assist J H King, vice-president, who continues executive direction of the dept. George A Mattucci and Edward L Boland have been made assistant manager and assistant to manager, respectively. Calvin H Lawrence has become the company's marine manager for Great Lakes district.

Selma Foundry & Machine Co, Selma, Ala., is now a distributor of Baldwin-Rex merchandise for **Baldwin-Duckworth** div of Chain Belt Co.

Frederick H Myers is district manager of new branch office in San Francisco opened by **Republic Flow Meters Co.**

L L Hedgepeth joins **American Cyanamid Co** as consulting engineer on industrial effluent problems and makes his headquarters at the Bound Brook, N. J. plant of the firm's Calco Chemical div.

Dearborn Chemical Co, Chicago, announces addition of E Stewart Carlson to their advertising staff. Also, William J Tobin is sales representative in the Minnesota territory with headquarters in the Minneapolis-St Paul area. Roy O Benson is assigned as sales representative to Chicago territory and will operate out of Dearborn's Chicago office. E W Houseknecht is sales representative in Wisconsin territory and makes his headquarters in Appleton, Wis.

Bernard H McGuiness has been appointed vice-president of Robins Conveyors div, Passaic, N. J. plant of **Hewitt-Robbins Inc.**

Canton Stoker Corp and Canton Pattern & Mfg Co, Canton, Ohio, jointly operated concerns, elect LeRoy C Dubs, president, to succeed his late father, Theodore M Dubs, founder and president of both companies until his death in October 1948. Other appointments include Glenn Theodore Dubs—treasurer of both firms and general manager of Canton Pattern & Mfg; William I Zink—vice-president of both; Fred Eisenberger—director of both and production manager of Canton Pattern & Mfg; Donald J Sprague—chief engineer and production manager of Canton Stoker; Harold Buchtel—office sales manager; Walter Sherman—factory superintendent.

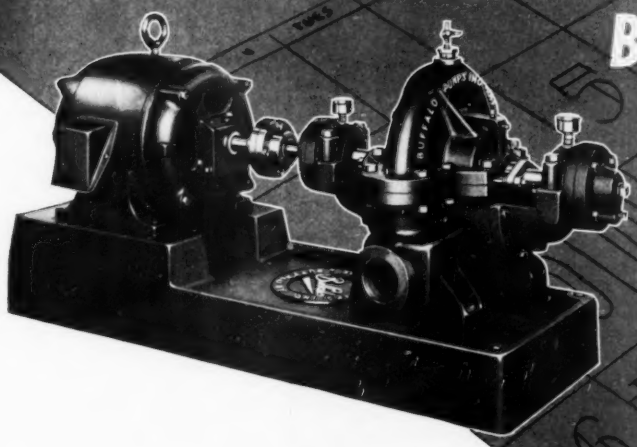
Additional assistant divisional parts managers are named by **Caterpillar Tractor Co,** Peoria, Ill., as follows: T A Dunne—Eastern div; J E Ferguson—Central div; W R Owens—Western div.

Merrill Brothers, Maspeth, N. Y., adds Howard L Franks to its staff as director of sales.

L J Suelzer becomes manager of newly created **Bowser** district office at 502 Oliver Bldg, Pittsburgh. T R Schannen succeeds Suelzer as manager of lubrication and filtration sales div at the home office in Fort Wayne, Ind. C P Menard is now sales engineer and will report to Suelzer.

Manning, Maxwell & Moore Inc, Bridgeport, Conn., announces appointments

Not "Cheap" in first Cost But Cheap to live with!



— AND THAT'S WHERE YOU REALLY SAVE MONEY IN A PUMP!!

When you can put in a pump that will do the job you want it to do, year after year—that pump pays for itself over and over! "Buffalo" Type "SL" Pumps are giving just this kind of "Extra" service to discriminating users—users who hardly know what pump troubles are. Oversize parts, from the high efficiency impellers to the husky bearings and shafts—plus the finest obtainable materials and workmanship—are the reasons for this long-term economy. Put a "Buffalo" Type "SL" Pump on your clear water job—and forget pump "headaches!"

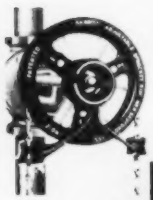
WRITE for Bulletin 955 and see for yourself the fine construction and workmanship that goes into these "Buffalo" clear water pumps — a "bonus" in years of extra service!

PUMPS BY "Buffalo"

BUFFALO PUMPS, INC.

488 BROADWAY BUFFALO, N. Y.
CANADA PUMPS LTD., KITCHENER, ONT.
Branch Offices in All Principal Cities

"A Better CENTRIFUGAL PUMP for Every Service"



HELP!

FOR EVERYONE WHO HANDLES VALVES OR PIPING

Babbitt *Adjustable* SPROCKET RIM *with Chain Guide*

● Range of 10 adjustable sizes takes care of all valve makes and types; fits valve wheel diameters from 2 to 30 inches.

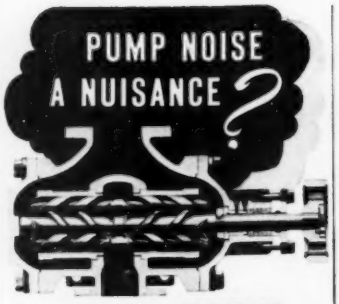
● Control overhead valves with ease and certainty, no matter how high up—right from the floor! No more climbing on bench, machine, boiler, treacherous stepladder. For overhead pipe layouts, plan on putting valves wherever needed. The BABBITT Adjustable Sprocket Rim with Chain Guide is especially designed for easy, positive control of those out-of-reach valves—from the floor.

● The BABBITT Adjustable Rim fits all valves, with either rising or non-rising stems. It is installed quickly by clamping onto the hand wheel of the valve.

● *Write today for Catalog Bulletin P, surprisingly low prices, and name of nearest distributor.*

BABBITT STEAM SPECIALTY CO.

1 Babbitt Square, New Bedford, Mass.



Install an IMO

The IMO Pump has no valves, reciprocating parts, or gears to cause noise and vibration The rotors of the IMO oil pump turn smoothly and quietly.

IMO pumps can be furnished for practically any capacity and pressure required for oil, hydraulic-control fluids and other liquids

Send for Bulletin I-144P.

IMO PUMP DIVISION of the
DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

HENSZEY *Boiler Feed* REGULATOR

Keeps a WATCHFUL EYE *on* BOILER WATER LEVELS

● CONTINUOUSLY ● AUTOMATICALLY ● ACCURATELY

under ALL LOAD CONDITIONS

They help avoid the hazards of high, as well as low, water levels. They function night and day—once installed and set for operation no attention is necessary — nothing to get out of order — nothing to rust.

A simple, compact unit — installs right in the line — no additional supports are necessary. Pressures up to 600 lbs., sizes up to 4 in.

Send for bulletin.

HENSZEY COMPANY
DEPT. D3, WATERTOWN, WISCONSIN

HENSZEY

BOILER FEED REGULATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

of Clifford E Mathewson, John R Parsons and A C Stauch as industrial instrument specialists. Mathewson is in the Pittsburgh district office in the Park Bldg; Parsons is attached to New York district office in Chrysler Bldg; and A C Stauch is in Chicago office at Field Bldg.

Welding Fittings Corp, New Castle, Pa., has purchased the business formerly conducted by Stainless Alloy div of **Pittsburgh Piping & Equipment Co.** Officers of the new company are: Allan W Beatty—*president;* Louis K Hamilton—*vice-president;* Joseph G Gardner—*secretary;* Thos S Elliott—*treasurer.* Board of directors consists of the officers and G Sinding Larsen. Pittsburgh Piping & Equip continues to manufacture and fabricate power piping as in the past.

Public relations activities of **American Locomotive Co** are now conducted from Schenectady, N. Y.

Hercules Motors Corp, Canton, Ohio, promotes John C Keplinger to executive vice-president.

James S Weaver has become associated with **Culbert Pipe & Fittings Co,** Jersey City, N. J., as special sales representative in the New York territory.

American Brake Shoe Co appoints Maynard B Terry vice-president of its American Brakeblock div, Detroit. Also, James J Nelson is made eastern sales manager of National Bearing div, Meadville, Pa., and Harry D Sweeney becomes sales manager of welding products for American Manganese Steel div, Chicago Heights, Ill.

P E Lakin has been elected executive vice-president of **Shell Oil Co.** He will serve as Shell's senior representative on the Pacific Coast, with headquarters in San Francisco.

SKF Industries Inc, Philadelphia, names C S Gotwals quality manager of all its plants. Charles R Scott Jr succeeds Gotwals as superintendent. W F Shedinger directs operations of machining div in addition to his duties as head of ball div.

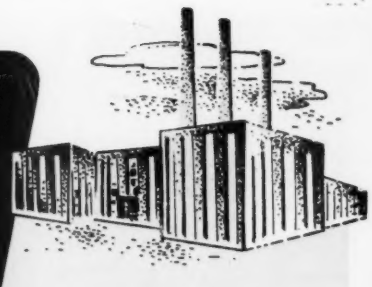
New headquarters of **All-State Welding Alloys Co** are at 273 Ferris Ave, White Plains, N. Y.

Allegheny Ludlum Steel Corp, Pittsburgh, elects Robert M Arnold, a director, to vice-presidency. Arnold is also president of Arnold Engrg Co, Chicago, a wholly owned subsidiary.

Glidden Engrg & Equip Co, represents **General Switch Corp,** Brooklyn, N. Y., as sales agents in Texas and Oklahoma through their offices in San Antonio, Dallas, Amarillo and Houston. From Los Angeles J C Richards Co acts as sales agent in the southern California area.

Modine Mfg Co, Racine, Wis., announces following elections in its organization: Charles T Perkins—*president;* Arthur F Thompson—*executive vice-president;* Ar-

Bernitz Piers . . . *for Spreader Stokers last 8 times longer than Clay types!*



Like users in many plants, you'll find that Bernitz *"Carbofrax" Piers last far longer, save maintenance dollars. That's because Bernitz Piers have special features which give you three outstanding advantages:

1. *Made from* *"*Carbofrax*" — tough, heat and abrasion resisting material.
2. *Exclusive air-cooled construction* — keeps piers clinker-free.
3. *Special high-temperature resisting anchors* — firmly secure piers to furnace front.

No wonder Bernitz Piers *retain their shape throughout their long life — help make more efficient use of fuel in your stoker.*

Let a Bernitz representative show you how Bernitz Piers can cut your fuel and maintenance costs.

**"Carbofrax" is the registered trade-mark of, and indicates manufacture by, the Carborundum Company.*

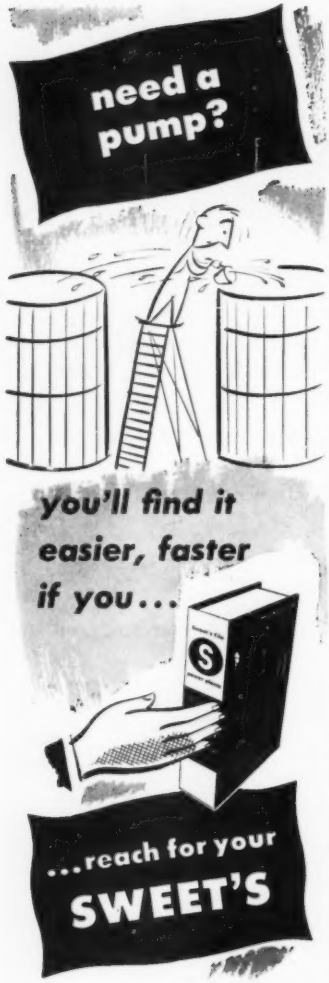
BERNITZ **Piers installed in a public utility plant in Massachusetts . . . have lasted 8 times longer than clay piers formerly used that had to be renewed every three months.**

OTHER BERNITZ PRODUCTS

Bernitz Air-Cooled Furnace Lining • Bernitz Air-Cooled Floors • Bernitz-Nygaard Water Wall Blocks for Walls and Arches
Bernitz Super-Generator Linings For Water Gas Sets

BERNITZ
"CARBOFRAX PIERS"

BERNITZ FURNACE APPLIANCE CO.
89 BROAD STREET, BOSTON 10, MASS.
NEW YORK — PHILADELPHIA — SYRACUSE — ATLANTA — PITTSBURGH — CLEVELAND — CINCINNATI — DETROIT — CHICAGO — INDIANAPOLIS — MINNEAPOLIS — KANSAS CITY — RENO
MONTREAL — TORONTO — WINNIPEG



When you need specific information on materials or equipment, reach for your Sweet's File for Power Plants (the big red file). It contains 118 manufacturers' catalogs full of useful information on thousands of products... from absorbers—gas, to zeolite. Cross indexing speeds finding.

If Sweet's File for Power Plants is not available in your office, make request immediately for application form. Files are distributed FREE to qualified organizations and individuals.

Sweet's

CATALOG SERVICE

for easier, faster selection of products

119 W. 40th ST., NEW YORK 18, N. Y.

thur G Dixon—*vice-president and secretary*. Reelected are: G H Jackson—vice-president in charge of purchasing; Robert Grant—vice-president in charge of manufacturing; E G Rutherford—treasurer. A B Modine continues as chairman of the board.

Plomb Tool Company promotes A L Hawley to works manager of the main factory in Los Angeles.

Hans A Bohuslav joins **R G LeTourneau Inc,** Peoria, Ill., as special engineering consultant to R G LeTourneau, president. Bohuslav will make Longview, Texas his headquarters.

W E Madden has become vice-president of George Haiss Mfg Co, New York City, subsidiary of **Pettibone Mulliken Corp,** Chicago.

Marcus Transformer Co, Hillside, N. J., appoints E B Cook Co, 1063 Howard St, San Francisco, as its territorial representative for northern California.

Floyd Rose continues as an active member of the board of directors of **Firth Sterling Steel & Carbide Corp,** McKeesport, Pa., although he has resigned as chairman. Michael N W de Berardinis has joined the company as manager of sales promotion and advertising.

James M Brown has been assigned to Tulsa, Okla., office of **Airetool Mfg Co** as company representative. Brown will handle territory including Oklahoma, north and west Texas, eastern New Mexico and Kansas. M E Segraves succeeded Brown as company representative in charge of Baton Rouge, La., office.

Hartford Steam Boiler Inspection and Insurance Co, Hartford, Conn., promotes T R Hardin to chief engineer of its boiler div.

Edmund McCarthy joins **Pittston Co** as consulting engineer with offices in Empire State Bldg, New York City. With a background of more than 25 years experience in combustion engineering and steamplant operation, McCarthy comes to the company from Fairmont Coal Bureau. In his present position he will collaborate with consulting engineers, equipment manufacturers, public utilities and industrial concerns in design of boilers and combustion equipment to ensure reasonable latitude in coal selection and lowest possible steam costs.

Engineering Controls Inc, Los Angeles and New York, has appointed A Tacchella as project engineer. Tacchella's headquarters are at 2835 E Eleventh St, Los Angeles.

Val Lobanoff is now assistant chief engineer for United Centrifugal Pumps, a div of **United Iron Works,** Oakland, Calif.

Ford, Bacon & Davis Inc, engineers of New York, Philadelphia, Chicago, and Los Angeles, announce election of E S Coldwell as president of the firm and its subsidiary, Ford, Bacon & Davis Construction

Investigate!!!

THE **AVAILABILITY** AND **ECONOMY** OF **FUEL OIL** AND **TODD BURNERS** FOR YOUR **BOILER PLANT!**

You'll find that for replacement of obsolete equipment or for new installations, Todd Burners will effect savings in fuel and maintenance costs. Skilled Todd specialists, modern Todd facilities—backed by 35 years of engineering experience—guarantee you economical burning of liquid and gaseous fuels. See your local Todd dealer now!

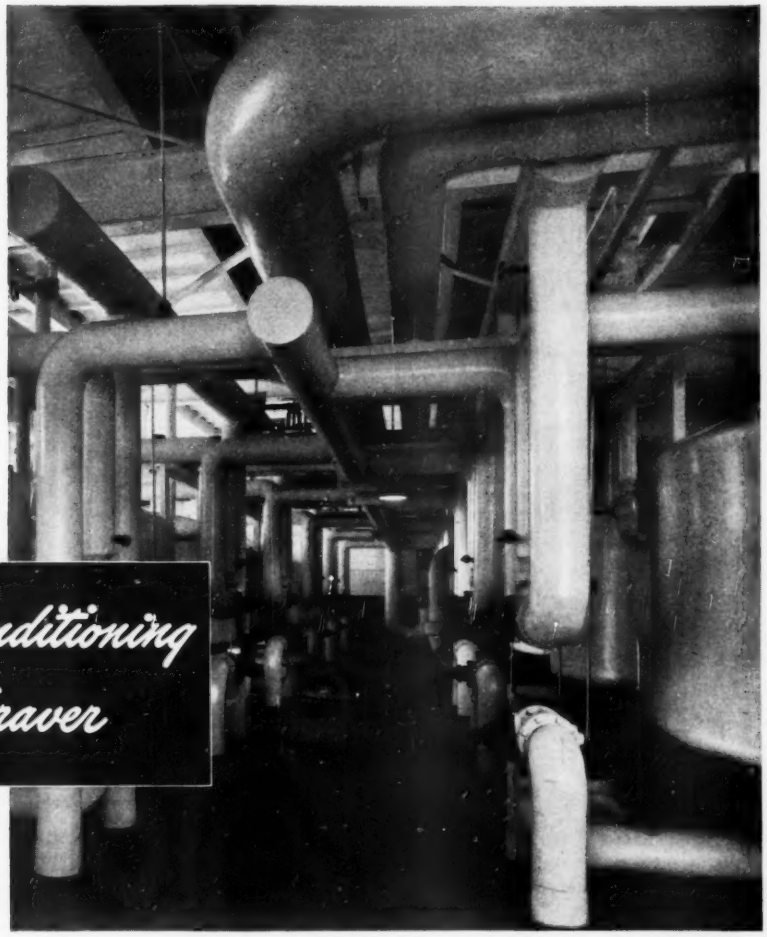
Oil Burners
Gas Burners
Combination Oil and Gas Burners

COMBUSTION EQUIPMENT DIVISION

TODD SHIPYARDS CORPORATION

81-16 45th Ave., Elmhurst, Queens, N. Y.

NEW YORK • BROOKLYN • ROCHESTER
BUFFALO • HOBOKEN • NEWARK • PHILADELPHIA
HARRISBURG • YORK • CHICAGO • CHARLESTON, S. C. • BOSTON • SPRINGFIELD, MASS.
BALTIMORE • WASHINGTON • RICHMOND, VA.
ATLANTA • DETROIT • GRAND RAPIDS • TAMPA
GALVESTON • HOUSTON • MOBILE • NEW ORLEANS • LOS ANGELES • SAN FRANCISCO
SEATTLE • MONTREAL • TORONTO
BARRANQUILLA • BUENOS AIRES • LONDON



Water Conditioning by Graver

PRESSURE WATER FILTERS—A PART OF THE COMPLETE GRAVER LINE

Water filters *may* be the solution to your water conditioning problem. If they are, Graver engineers will recommend their installation. But, if another type or a combination of equipment will meet your requirements more efficiently, more economically, then Graver engineers will recommend that type.

The Graver line is complete. It includes all types of water conditioning equipment . . . Reactivators, hot process softeners, zeolite softeners, demineralizers, deaerators, condensate conditioners, plus the various combinations of these types that specific conditioning problems demand.

Avoid the danger of installing the wrong equipment. Call in a Graver engineer today. Get a sound, impartial recommendation. There's no obligation.

Water Conditioning and Process Equipment Division

GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA

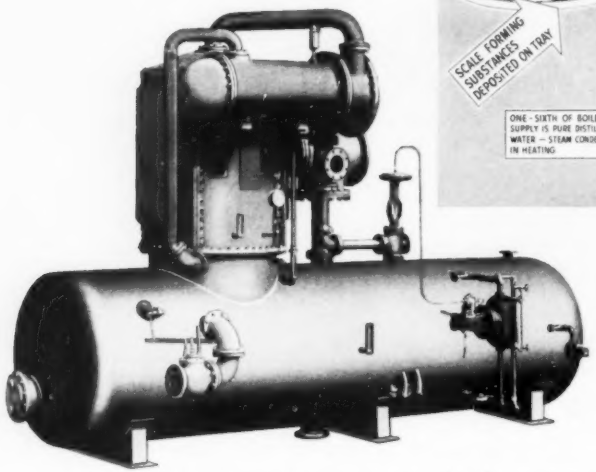
NEW YORK PHILADELPHIA CHICAGO

Reduce Cost OF STEAM AND BOILER MAINTENANCE

Stickle OPEN COIL Heaters Economically Provide Purified and Preheated Feed Water in Adequate Supply

● Feed water is delivered to pump by a Stickle Deaerating Heater at saturated temperature of steam with oxygen held at .005 to .03 cc. per liter. The larger quantities of scale-forming substances are removed. Water travels from top in a thin film, through an irregular course over a series of trays, in direct contact with steam. Heat transfer is rapid; scale-forming substances are deposited on trays; non-condensable gases are released. Admission and overflow automatically controlled. Ask for Bulletin No. 117.

OPEN COILS SUPPLY RAPID HEAT TRANSFER
SCALE FORMING SUBSTANCES DEPOSITED ON TRAY
ONE-SIXTH OF BOILER SUPPLY IS PURE DISTILLED WATER — STEAM CONDENSED IN HEATING



A Stickle Deaerating Heater recently installed by a Montana lumber manufacturer. Heating capacity, 150,000 lbs. per hour. Storage section, holding 15 minutes boiler supply, equipped to maintain constant uniform water line . . . Stickle Heaters made for capacities from 3,000 to 300,000 lbs. per hour.

STICKLE STEAM SPECIALTIES COMPANY
2265 Valley Avenue, INDIANAPOLIS 18, INDIANA

Successfully Serving for More than 40 Years Paper Mills, Food Processors, Textile and Hosiery Mills, Laundries and Other Manufacturers Using Steam for Industrial Processing

STICKLE EQUIPMENT

STICKLE DIFFERENTIAL AND BOILER RETURN SYSTEMS • STICKLE OPEN FLOAT STEAM TRAPS • STICKLE REGULATING AND REDUCING VALVES • STICKLE OPEN COIL FEED WATER HEATERS AND PURIFIERS • STICKLE OIL AND STEAM SEPARATORS STICKLE TEMPERATURE CONTROLLERS AND OTHER SPECIALTIES

Corp, Monroe, La. Goldwell succeeds James F Towers who actively continues as chairman of the board of both companies.

Drazen & Associates, consulting engineers, formerly Michael Drazen & Associates has moved to 8135 Forsythe Blvd, Clayton, St. Louis 5, Mo.

Daniel S Pelletier has been made a partner in the firm of **Sanderson & Porter,** New York City, engineers and constructors, after more than 30 years service.

Recognizing the trend toward air pollution studies, **Sam Tour & Co,** New York City, consulting engineers, has augmented its staff by securing services of Robert E Barnett, B S who has had extensive experience in atmospheric sampling and analysis.

H K Ferguson Co, industrial engineers and builders, establishes western district office at 712 Curson St, Los Angeles, under management of Henry Maag.

W R Smith Jr resigns as engineering sales manager of **Carlyle Johnson Machine Co,** Manchester, Conn. Smith plans to become a manufacturers' representative, specializing on sale of machine parts and mechanical power transmission components calling for engineering application. His offices will be at 1006 Main St, Hingham, Mass.

Fay, Spofford & Thorndike, Boston consultants, names Frank E Reeves power plant electrical engineer. Reeves is assigned to the Alaska Project with headquarters at 55 Tremont St, Boston.

Fred A Boddy, Max W Benjamin and Frederick H Potz have organized a firm, **Boddy-Benjamin Associates Inc** at 2210 Park Ave, Detroit. Boddy was vice-president and chief engineer of H E Beyster Corp for 7 years; and Benjamin, a specialist in power house design, was with Detroit Edison Co for 19 years. Potz was architect-in-charge for Albert Kahn Inc, for 22 years. The firm is equipped to render complete architectural and engineering services on industrial, commercial and public buildings or industrial and public utility power plants.

Detroit Edison Co appoints George A Porter and Henry E Macomber chief engineer and assistant chief engineer of its power plants, respectively. William W Brown is now mechanical engineer of power plants.

E Clyde McGraw has been transferred to New York office of **Stone & Webster Service Corp,** where he will be vice-president in charge of advisory service to Transcontinental Gas Pipe Line Co. Herbert A Murphy succeeds McGraw at Boston as vice-president in charge of New England utilities.

American Society of Mechanical Engineers has designated Frank S G Williams of New York, eastern manager of Taylor Forge and Pipe Works, as chairman of ASA sectional committee B-31,

(*Continued on page* 226)

Metallurgical Research conducted continually by recognized specialists who have made major contributions in this field.

Unique Technical Backing of an extensive organization with an international reputation in both process and fabrication engineering.

Complete Facilities for the fabrication of steel products from simple forgings to the most intricate 120 foot towers.

Top Welding Performance assured by specially designed equipment and exclusive employment of master operators.

Quality Control embracing the constant application of the most advanced inspection methods, both visual and non-destructive.

On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.

This fellow starts where the shop leaves off!

THIS welder is on a job site—in a power house far from Kellogg's plant. He's only one of a crew installing power piping which Kellogg prefabricated. But what he and his partners do, away from the critical eyes of the plant metallurgists and technicians, will go a long way toward determining whether the new piping being welded into position stands up to its "built-in" performance possibilities.

Faulty metal formations can on occasion flow from the end of any welding rod . . . locked-up stresses can be established through carelessly controlled heat treating practices . . . even the fitters, who install the temporary supports before welding can cause damaging stresses in this piping that came through plant inspection with flying colors.

Only experience and knowledge of "what not to do" and expert supervision can preserve the basic qualities built into that piping at the plant. And that should be reason enough for purchasers to consider carefully the relative efficiency and quality of installation forces *before placing orders for critical power piping.* For in essence these installation crews establish final performance of installed piping.

The high repute in which Kellogg installation work is held is the result of more than thirty years of daily association with power piping of all types.

It is the result of knowing where and how to apply positive checks of quality!

It is the result of building over the years a force of supervisory personnel capable of assimilating the pertinent metallurgical information uncovered with each additional day's experience.

It is the result of manning each job with trained, tested and experienced piping engineers, welding inspectors, and stress relieving technicians.

It is all of these plus a management approach which demands that Kellogg piping *in the power line* retain every performance property built into it *at the fabricating plant.*

FABRICATED PRODUCTS DIVISION

THE M. W. KELLOGG COMPANY

A SUBSIDIARY OF PULLMAN INC.

NEW YORK • JERSEY CITY • BUFFALO • LOS ANGELES
TULSA • HOUSTON • TORONTO • LONDON • PARIS

KELLOGG

VESSELS • EXCHANGERS • CONDENSERS • HIGH PRESSURE AND HIGH TEMPERATURE POWER PIPING
PROCESS PIPING • FORGED AND WELDED FITTINGS . . . IN ALL STEELS, ALLOYS OR SPECIAL COMBINATIONS

EISLER TRANSFORMERS

STANDARD & SPECIAL

From ¼ to 400 KVA up to 15,000 volts

We manufacture a complete line of:

*AIR, OIL OR WATER-COOLED DISTRIBUTION TRANSFORMERS

*Special Designs available to meet Customers' Specific Requirements

TRANSFORMERS FOR
*ELECTRIC FURNACES
*WELDING
*HEATING
*PHASE CHANGING
Etc.

POWER & LIGHT TRANSFORMERS

For isolation of Light from Power, or Light from Telephone

EISLER TRANSFORMERS are manufactured strictly to Standards of the N.E.M.A., A.S.A., and A.I.E.E.

WRITE FOR SPECIAL CATALOG

EISLER ENGINEERING CO., INC.
Chas. Eisler, Pres.
757 South 13th Street, Newark 3, N. J.

Learn the secret of

BIG EARNINGS

in Combustion Engineering

Through the Hays easy reading home study course . . . .

High power plant costs today have opened up big opportunities for men who know the means of producing efficiency and economy in power plant operation. The above booklet sent to you without obligation, will tell you of the easy way to become a Hays trained Combustion Engineer, in a little of your spare time, through the easy reading, low cost, Hays Home Study Course in Fuel and Combustion Engineering. Send for it now.

Approved for Veterans. Our 30th Year.
HAYS INSTITUTE OF COMBUSTION. Dept. 13
430 North Michigan Ave., Chicago 11, Illinois

HAYS INSTITUTE OF COMBUSTION
430 N. Michigan Ave., Chicago, Ill. Dept. 13

Name_____

Address_____

City_____ State_____

Company Name_____

Uses Lang-Lay Rope For Elevator Service

In the article, "How to Choose the Proper Wire Rope Construction," p 467, August POWER, the author failed to mention the use of lang-lay ropes for elevator service.

I have used them on a large number of elevators and find their life not less than three times the normal life of seale preformed and five times seale non-preformed, based on actual experience to date. In this experience no lang-lay ropes have been condemned or removed. There is a possibility that life of the ropes may exceed the figures given.

Normal stretch of these ropes is so small that it has not been necessary to shorten them when properly installed, except possibly under extreme circumstances. After they are once properly installed, tension adjustment is not required because the ropes do not stretch, but we check them periodically, nevertheless.

These ropes have about 40% more surface in contact with traction-sheave grooves, which insures less slippage and wear on the ropes in the grooves. These ropes do not twist as they run in the sheave grooves, which also helps to reduce wear.

Lang-lay rope, being more flexible than regular-lay constructions, gives better service than the latter do on small sheaves. They also permit faster acceleration and retardation of the car without sliding in the sheave grooves.

CLAUDE I. SPRAY *Bayside, N. Y.*

Industrial instrument maintenance and repair courses, which have been conducted for the past 15 years by Brown Instruments Div of Minneapolis-Honeywell Regulator Co, will be divided during the first six months of this year into four classes of five weeks each, and longer courses for company personnel.

In announcing the broadening of its instruction for benefit of industry and for its own personnel, M J Ladden, head instructor of the Philadelphia instruments maker school, made known that the course for company personnel started Feb 21. It is subdivided into specific classes for instruction in millivoltmeters, mechanical pyrometers, continuous balance electronic potentiometers, electrically operated automatic control, flowmeters, thermometers, pressure gages and hygrometers, air-operated control, Moist-o-Graphs, tachometers, resistance thermometers, CO_2 and analygraph.

The five-week classes will continue through June 17.

Southern Iowa Electric Co-operative, Bloomfield, Iowa, has received bids on a 690- to 830-kv diesel engine generating unit complete with auxiliaries. Stanley Engineering, Muscatine, Iowa are the consulting engineers.

Municipal power plant at Sioux Center, Iowa has awarded contracts for a diesel engine generating unit and auxiliaries. Buell and Winter, Sioux City, Iowa are consulting engineers.

CHECK LIST OF
Practical Books for
Practical Power Men

1. AMERICAN ELECTRICIANS' HANDBOOK

Detailed descriptions, rules, methods, and practical wiring data are what this practical book puts at your fingertips. It helps you install, maintain, and operate electrical equipment of all types by giving you the fundamental facts and theories of electricity in today's applications. A book every practical electrical man should have, especially those with little mathematical training who want a working knowledge of electricity. By TERRELL CROFT—revised by CLIFFORD CARR. New 6th Edition Based on the 1947 National Electrical Code. $6.00.

2. PRACTICAL ELECTRICAL WIRING
Residential, Farm and Industrial

Every medium-voltage wiring and installation job you tackle becomes easier with the aid of this book. It shows you how to plan and carry out all types of light and power wiring jobs on the farm, in homes, factories, stores, schools, etc. Hundreds of on-the-job tips, hints, and short-cut suggestions, plus the fundamental and basic principles of all phases of electrical wiring. By H. P. RICHTER. Based on the 1947 National Electrical Code, 3rd Edition. $3.75.

3. Troubles of Electrical Equipment
Their Symptoms, Causes, and Remedy

Shows you how to spot troubles . . . and tells you what to do about them. A sure-fire guide giving you hints, suggestions, and guidance for locating quickly motor, transformer, relay, and other equipment troubles. Covers a-c and d-c apparatus used in the average industrial plant—gives tips on efficient operations and maintenance. By H. E. STAFFORD. 3rd Edition. $4.50.

4. Electrical Distribution Fundamentals

Essential data on design and construction, operation and service, methods and equipment, mechanics and materials on all types of electrical distribution systems. It provides workable solutions to problems of foremen, linemen, electricians, troublemen, repairmen, and inspectors. Expert advice on problems involved in distributing electrical energy anywhere between the major substations and the customer's meter. By FRANK SANFORD. 2nd Edition. $3.50.

5. Controllers for Electric Motors

Helps you get maximum power and use out of electric motors. It guides you in selecting the right controllers for your particular load requirements, and explains modern control apparatus, uses of the electron tube, magnetic contractors, time-limit methods of acceleration, development of plugging control, and of the Regulex, Ampledyne and Rototrol, and new types of time-delay overload relays. By HENRY D. JAMES and LEWIS E. MARKLE. $4.00.

6. Industrial Electricity & Wiring

This book explains the fundamentals of electricity and standard methods of wiring. It covers electrical wiring for every industrial application. Not only does it give you the standard, economical, and efficient methods for doing every type of wiring, but it grounds you in electrical theory, action, and application of apparatus, principles of power circuits, etc. By JAMES A. MOYER and JOHN F. WOSTREL. 3rd Edition. $3.50.

7. INSULATION OF ELECTRICAL APPARATUS

The key to insulation problems for the designer and user of electrical apparatus. It correlates theory and design in a well-rounded treatment that discusses present knowledge of dielectric behavior, describes the problems encountered in insulating the major forms of electric power equipment and how they are solved, and shows what tests are of value in determining the performance of insulation. By DOUGLAS F. MINER. $8.00.

8. COMBUSTION ENGINES

For quick solutions to internal combustion engine problems consult this guide for the theory and application of reciprocating and gas turbine types. You get intensive coverage of these engines . . . from elementary theory to practical applications and engineering methods . . . from basic working concepts of combustion to thermodynamic charts of the products of combustion. By ARTHUS P. FRAAS. $5.50.

EXAMINE THESE BOOKS 10 DAYS FREE

McGraw-Hill Book Co., Inc., 330 W. 42 St., NYC 18

Send me books corresponding to numbers encircled below for 10 days' examination on approval. In 10 days I will remit for the book(s) I keep, plus few cents delivery charges, and return unwanted books postpaid.*

1. 2. 3. 4. 5. 6. 7. 8.

Name_____

Address_____

City_____ Zone_____ State_____

Company_____

Position_____ P-3-49

This Handy Selection Chart

Answers the Question...

A WIDE SELECTION OF SPEED
FOR USE WHERE SHAFT IS ACCESSIBLE
FOR USE WHERE SHAFT IS INACCESSIBLE
FOR MEASURING CYCLES OR VIBRATIONS PER SECOND OR MINUTE

"What Speed Measuring Instrument Shall I Use?"

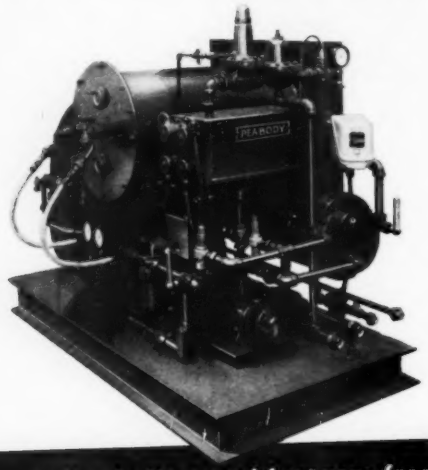
The quick-reference selection chart and index, illustrated above, tells you at a glance which type of Biddle instrument to use for your particular speed measuring problem. This handy guide is but one of many helpful features found in a newly-published bulletin, which contains descriptions, illustrations, and other data on our resonant-reed, chronometric, and centrifugal types of high quality speed measuring instruments. We would be pleased to send you a *free* copy of this new Biddle bulletin with selector chart. Your request will bring it to you promptly. Simply ask for Bulletin 35-P.

JAMES G. BIDDLE CO.

Electrical & Scientific Instruments

1316 ARCH STREET, PHILADELPHIA 7, PA.

A COMPLETE AUTOMATIC OIL BURNER SYSTEM



to fire boilers and furnaces from 100 developed HP upward

If you're interested in improved plant layout, low operating costs, and reduced overhead on your heating and power plant installations, you'll be interested in the Peabody Automatic Burner. Designed, built, and engineered by Peabody, the Automatic Oil Burner is a compact, complete oil combustion system that takes Bunker "C" or lighter oils from your storage tank, pumps it, preheats and delivers it to the burner at the proper viscosity and then burns it at the specified firing rate dictated by operating demands.

DEPENDABLE

The Peabody Automatic Burner is listed by Underwriters' Laboratories, Inc. and has a complete system of checks, safeguards, and automatic controls to maintain the required firing rate that assures maximum efficiency and safety at all times. Available for both fully-automatic and semi-automatic operation.

READY TO INSTALL

The entire assembly is mounted at the factory on a common base. No extra construction or engineering necessary to put it into operation. Just bolt it to furnace front, and make necessary service connections. It's simple, safe, and dependably economical!

GET COMPLETE DETAILS . . . WRITE FOR BULLETIN 400 TODAY

PEABODY
ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK 19, N. Y.
Manufacturers of all types of combustion equipment, direct-fired air heaters, gas scrubbers, coolers, and absorbers.

204

OFFICES IN PRINCIPAL CITIES

(Continued from Page 222)

which is responsible for American Standard Code for Pressure Piping.

Florida Power Corp promotes O H Ware Jr to assistant chief engineer at its Avon Park plant.

John J Loustaunau, chief electrical engineer of E B Badger & Sons, Boston, has been elected president of **Massachusetts Society of Professional Engineers.**

Midwest Research Institute announces appointment of Dr George E Ziegler as director and Dr Clayton O Dohrenwend as assistant director of the Institute.

OBITUARIES

William Oberst, 57, chief stationary engineer with Buffalo Theaters Inc, Buffalo, N. Y., for the last 22 years, died Dec 21 of a heart attack at his home.

Howard D Slade, 69, stationary engineer at Hotel Syracuse, Syracuse, N. Y., for 21 years, and stationary engineer at Syracuse Court House for the last 2 years, died Dec 30 after an illness of two months.

Guy H Knowlton, 66, power engineer and manager of Root Neal & Co., Buffalo mill supply firm, died Jan 3 after a six months illness.

Ernest H Forster, 84, mechanical engineer and inventor as well as co-founder and director of Foster Wheeler Corp, died Jan 23 at Ormond Beach, Fla.

Clean Turbines

(*Continued from page* 81)

header, a reduced pressure results. This in turn opens up all admission valves and what's more important allows enough steam to pass through to carry out all spray water.

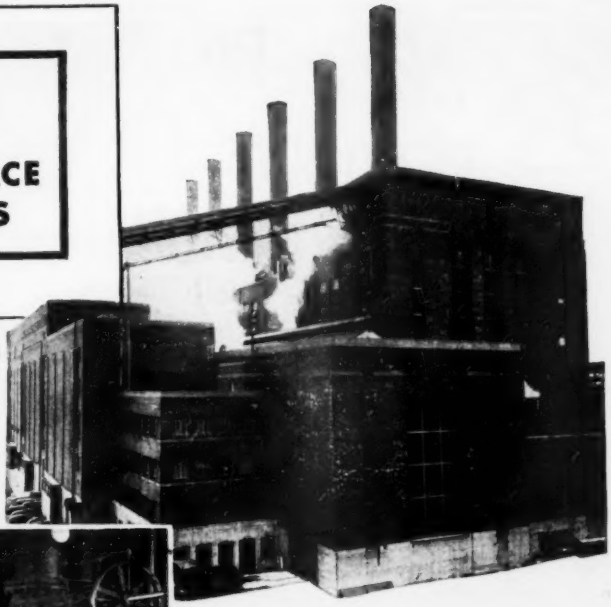
Still another suggestion that might prove helpful is to admit the water for washing at a point in the steam chest of the turbine itself. Such an arrangement, while not used by us, has been advanced as giving one extra advantage —a wash-cleaning of the turbine nozzles themselves.

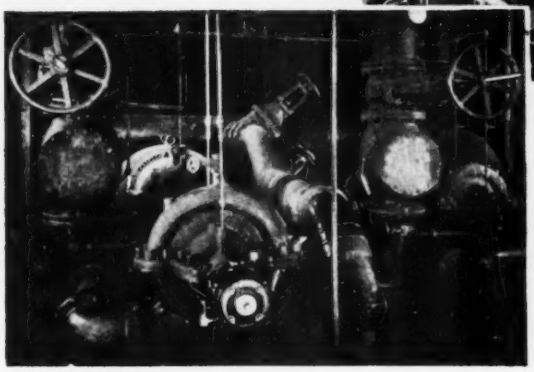
While turbine-washing under load can be a fairly simple process, it requires a well thought-out program, carefully supervised and carried out to go off smoothly. Results, though, are worth the effort. We test our turbine unit by applying a high-power-factor load (around 97%) after the 2-hr washing program and find that we can load to about 9300 kw on our 7500 kw, 0.8-pf machine.

OIC

SETS THE PACE IN VALVES

"MISSISSIPPI MUD" provides proof





The Union Electric Company, whose plants generate electric energy for distribution to both industrial and domestic consumers in St. Louis, Mo. and adjacent territory, is using OIC Valves extensively in its new 400,000 KW plant at Venice, Ill.

●

WHEN Union Electric built the first unit of their plant at Venice, Ill., OIC Valves — and others — were used in the pump house during the unwatering of the caisson. These valves were continuously subjected to raw Mississippi River water with its high turbidity and consequent severe scouring action.

The OIC Valves came through with flying colors!

When Union Electric needed additional valves, both for temporary use and for permanent installations, OIC Valves were selected.

Hundreds of similar experiences show why, day by day, OIC is becoming known as "Pace-Setter in Valves"!

Check These Pace-Setting Features!

- Leak-proof joints guard against disastrous pressure-drop.
- Streamlined designs protect flow from turbulence.
- Heavier construction throughout keeps pressures and stresses within safe bounds.
- Wedges of heavy I-beam design provide positive, leak-proof closure, or open the streamlined ports for smooth, even, *free* flow!
- Integral body ribs guide the wedge to its seats with unerring accuracy — effectively reduce vibration and wear.

0-249-17

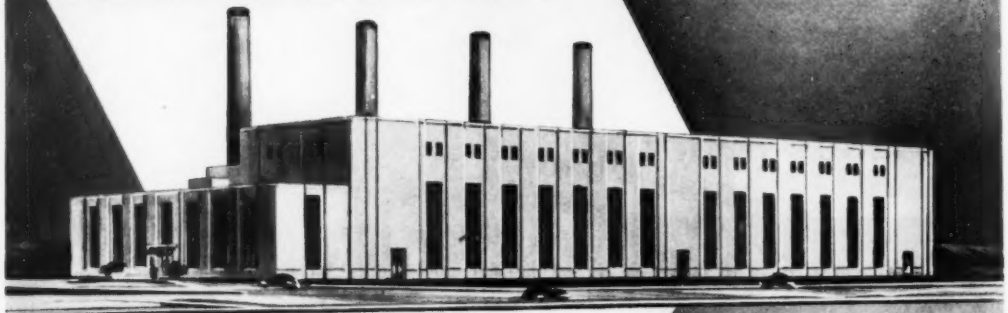
Write For Handy OIC Cross Reference Chart — Eliminates Valve Change-Over Problems

Simply check the number of the valve you wish to replace, look at the chart, and you'll find the right OIC valve. Write to The Ohio Injector Company, Wadsworth, Ohio, for your free copy.

OIC VALVES

STEEL • IRON • BRONZE

For the new
REDONDO STEAM STATION
SOUTHERN CALIFORNIA EDISON CO.



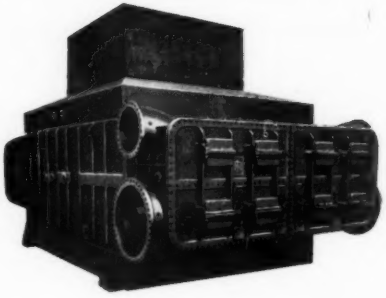
4 INGERSOLL-RAND CONDENSERS

Los Angeles county has probably had the greatest rate of growth during the past ten years of any metropolitan area in the United States. Manufacturing establishments alone increased from 5549 in April 1939 to 7231 in January 1947. In this same period there were 3215 new plant expansions. No wonder the demand for power has grown!

As a result the new 264,000 kw Redondo Steam Station is now being built by Southern California Edison Company under a contract with Stone & Webster Engineering Corporation. The station is located only a few hundred feet from the ocean at Redondo Beach, California, and when completed it will contain four 66,000 kw turbine-generators, *each served by an Ingersoll-Rand 42,500 sq ft rectangular condenser.*

Operating conditions of the plant will be 850 psi, 900°F steam and condensing water will be drawn from the ocean. The first two units are now being put into operation. They will be served by Ingersoll-Rand vertical circulating water pumps, I-R vertical condensate pumps and condensate booster pumps. Other Ingersoll-Rand equipment includes two compressors for supplying oil-free air for instrument control and one large synchronous motor-driven compressor for plant air.

The choice of Ingersoll-Rand condensers and auxiliaries for the Redondo Steam Station is the result of confidence based upon hundreds of other outstanding I-R condenser installations. If you are thinking of expanding your power generation facilities, then the next step is to get in touch with an Ingersoll-Rand engineer. He can show you how recent I-R advances in condenser plant design have benefited central stations throughout the country.



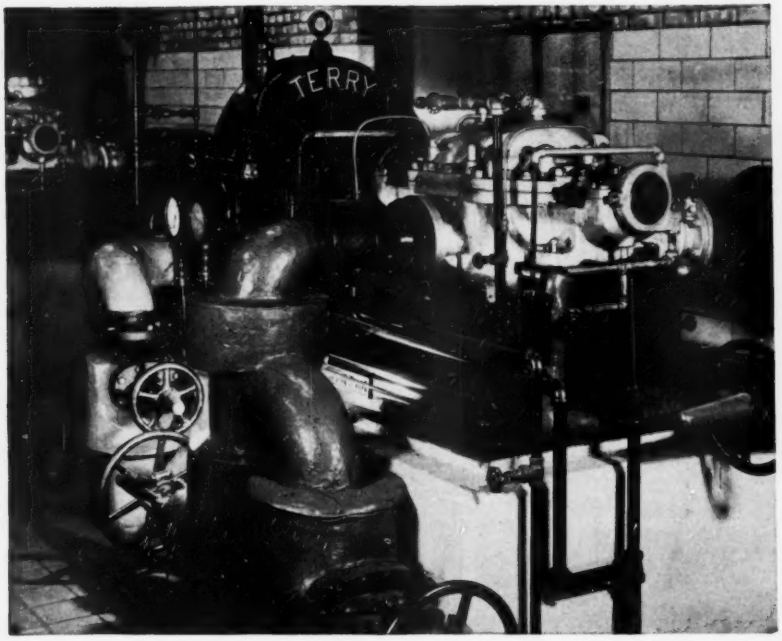
Ingersoll-Rand

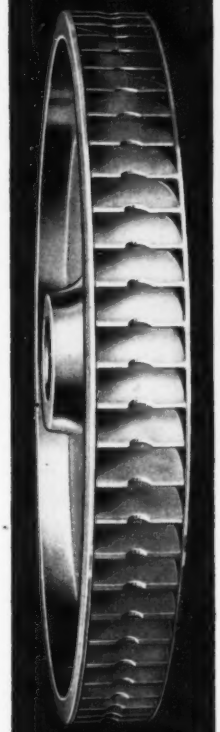
11 BROADWAY, NEW YORK 4, N. Y.

214-4

COMPRESSORS • AIR TOOLS • ROCK DRILLS
TURBO BLOWERS • CONDENSERS
CENTRIFUGAL PUMPS • OIL AND GAS ENGINES

TERRY





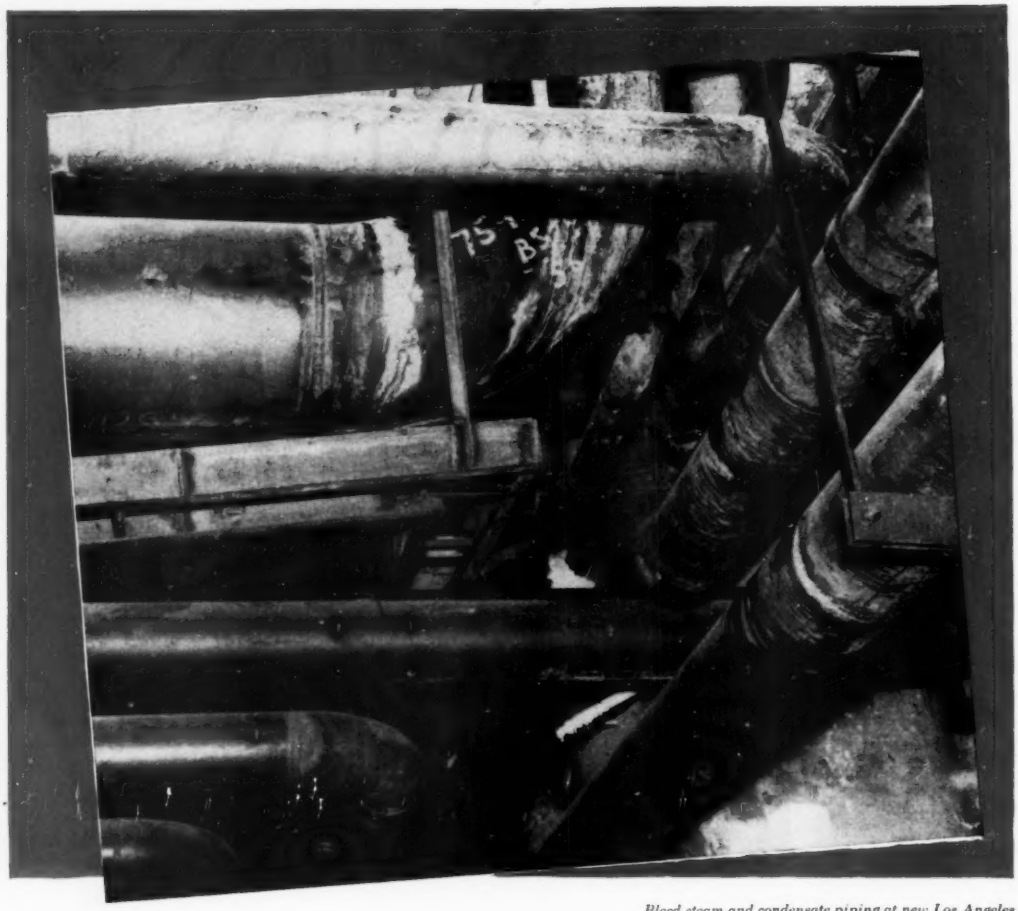
110hp Feed Pump Turbine with Large Safe Clearances

The blades of this turbine are milled out of a one-piece forged-steel wheel with generous clearance both radially and axially. The side clearance is very large — one inch — and the blades are protected by a projecting rim on each side of the wheel. It is therefore impossible for the blades to foul and end play can do no damage to the turbine.

These are but a few of the features that make the Terry Solid-Wheel Turbine such a dependable driver. A bulletin giving other interesting facts about this turbine will be sent upon request.

T 1179

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.



Bleed steam and condensate piping at new Los Angeles Harbor Steam Plant, Wilmington, Cal.

Piping permanence for City of The Angels

EVERYTHING is big about Los Angeles Department of Water and Power's new Harbor Steam Plant: Per-day sea water consumption, 415 million gallons. Boilers high as eight-story buildings. Turbines weighing approximately 500 tons each.

This investment is being protected by the most durable piping in the world. Welding fittings—*the fittings that become part of the pipe*—are used, and ninety per cent of them are Tube-Turn welding fittings.

Some of the piping would be difficult to get at for maintenance. But there is no maintenance, with the permanently leak-proof welded joints, and with metal structure and strength at least equal to straight pipe in Tube-Turn welding fittings.

Their smoothly functional design permits close nesting, saves space and weight. Smooth inner walls minimize erosion and pressure loss. Dimensional accuracy makes for good alignment, sound welds.

Moral: Only the best is good enough for power piping. And all things considered, the best is the most economical.

TUBE TURNS, INC.

236 E. Broadway, Dept. F, Louisville 1, Ky.

District Offices at New York, Philadelphia, Pittsburgh, Chicago, Houston, San Francisco, Los Angeles

Write for booklet of tables, "Allowable Working Pressures of Tube-Turn Welding Fittings."

TUBE-TURN

tt

WELDING FITTINGS AND FLANGES

YOUR COMMUNITY

needs the safety

and lasting dependability of

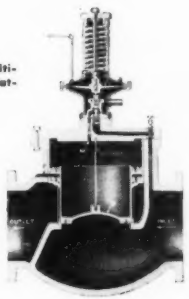
GOLDEN-ANDERSON

positive control **VALVES**

Sensitive Golden-Anderson Altitude Control Valves maintain water levels within 3" to 12" variations, and may be arranged with special equipment to perform a variety of other services.

Inherent water cushioning prevents shock or jar under varying flow conditions. These Valves are easily adjusted for any water level, and include an indicator which shows piston position at all times. Some models actually are two valves in one—a regular automatic Altitude Control Valve as well as a Reverse Flow Check Valve.

Let Golden-Anderson protect life and property through *absolute, safe control* of difficult flow conditions.



G-A Single Acting Altitude Valve, Globe Pattern.

GOLDEN-ANDERSON *Valve* Specialty Co.
Keenan Building, Pittsburgh 22, Pa.

LIFE AND PROPERTY PROTECTION
VALVES SINCE 1905

A Cottrell Precipitator Installed by Research Corporation

WILL COLLECT OVER

95%

OF YOUR FLY ASH

A Research Corporation Cottrell will effectively clean stack gases by removing over 95% of all the different size fly ash particles suspended in the gas.

It will operate with a low draft loss, averaging only a few tenths of an inch of water across the Cottrell. The electrical power required for energizing the Cottrell is extremely low, amounting to only .5 to 1.0 KWH per 100,000 cubic feet of gas cleaned.

The *plus* efficiency of Research-installed Cottrells is assured by Research's experience gained in over 35 years and 1100 installations. This knowledge is essential to successful dust control, for every application presents its own peculiar problems. Each installation must be individually engineered.

Research-Cottrells can be installed to furnish any degree of efficiency desired, and to handle any volume of boiler gas. Full information is presented in an interesting 28-page bulletin. Write for your copy today.

Research Corporation Installations

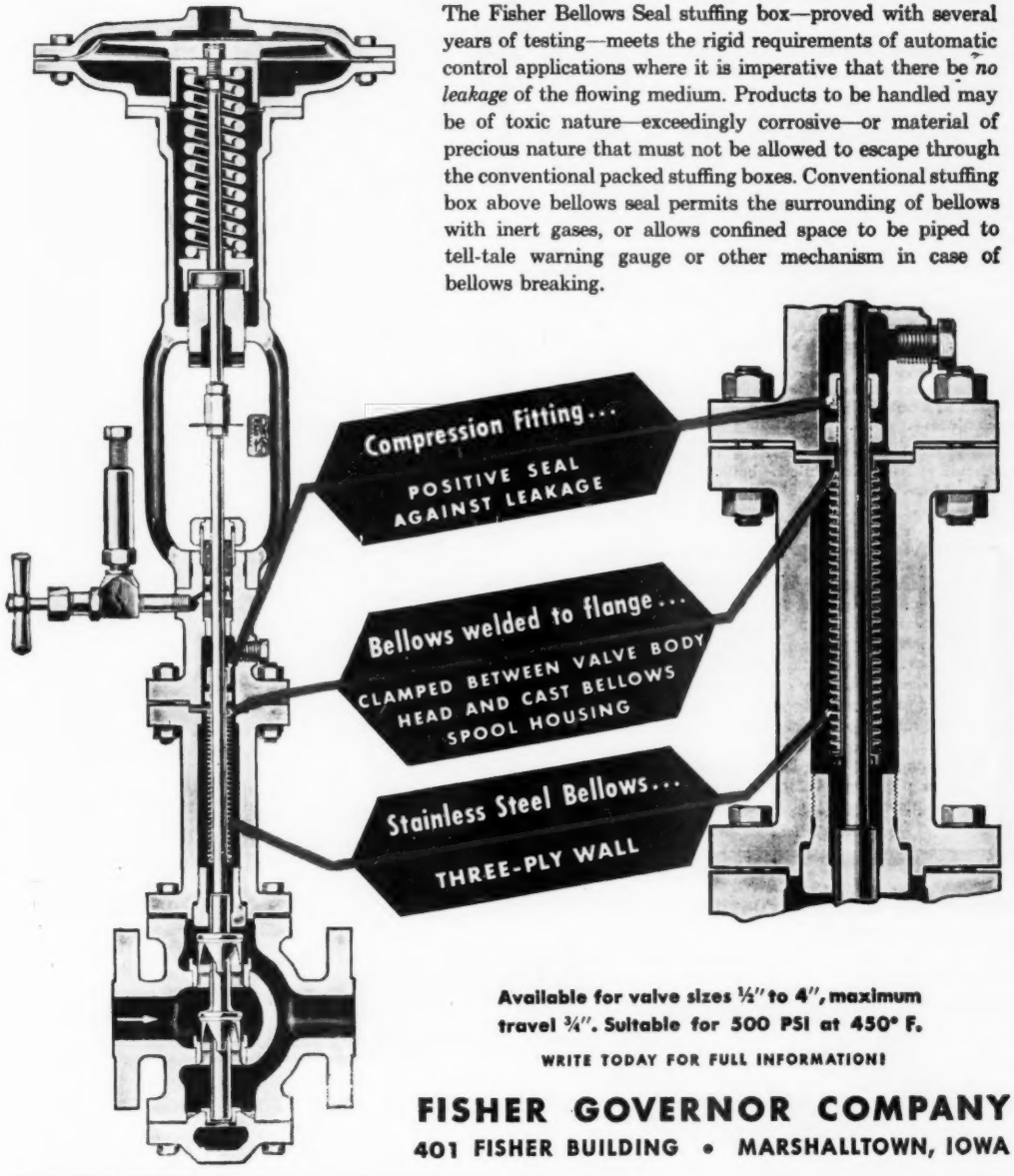
47 CARBON BLACK PLANTS
200 METALLURGICAL INSTALLATIONS
203 ACID PLANTS • 34 PAPER MILLS
262 DETARRING INSTALLATIONS
195 POWER STATIONS
71 STEEL PLANTS • 95 OIL REFINERIES
AND MISCELLANEOUS INSTALLATIONS

RESEARCH CORPORATION

405 Lexington Avenue, New York 17, N. Y.
122 South Michigan Avenue, Chicago 3, Illinois

SEALED

The Fisher Bellows Seal stuffing box—proved with several years of testing—meets the rigid requirements of automatic control applications where it is imperative that there be *no leakage* of the flowing medium. Products to be handled may be of toxic nature—exceedingly corrosive—or material of precious nature that must not be allowed to escape through the conventional packed stuffing boxes. Conventional stuffing box above bellows seal permits the surrounding of bellows with inert gases, or allows confined space to be piped to tell-tale warning gauge or other mechanism in case of bellows breaking.


Compression Fitting...
POSITIVE SEAL AGAINST LEAKAGE
Bellows welded to flange...
CLAMPED BETWEEN VALVE BODY HEAD AND CAST BELLOWS SPOOL HOUSING
Stainless Steel Bellows...
THREE-PLY WALL

Available for valve sizes ½" to 4", maximum travel ¾". Suitable for 500 PSI at 450° F.

WRITE TODAY FOR FULL INFORMATION!

FISHER GOVERNOR COMPANY

401 FISHER BUILDING • MARSHALLTOWN, IOWA

B-L furnace enclosures lower maintenance costs

● Unit-suspended walls and arches not only provide top operating efficiency, but lower maintenance costs as well. Here's how:

By cutting the *size* of the repair job. *Unit* repairs are possible; only worn tile need be replaced, other areas—above, below, at the sides—are untouched. Result: less handling, less labor, less tile replacement.

By reducing the *time* spent for repairs. Installation "outage" changed from days to hours. Furnaces get back on the line—*fast*. In the pictures at the right, punishing operating conditions have induced wearing on the Bigelow double wall. After cooling, *only* the worn tile have been removed; adjacent areas remain as sturdy as before. In the third picture, the repaired wall is just like new.

Unit-suspension avoids loading tile on top of tile and resulting cumulative stresses and strains. Mechanical spalling caused by pinching, buckling and other thermal movements is eliminated.

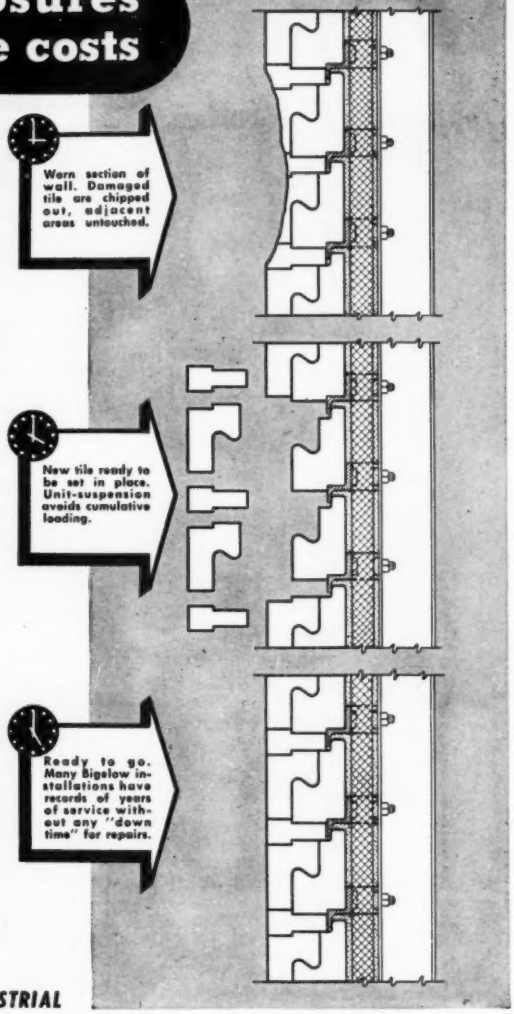
Specify Bigelow-Liptak suspended furnace enclosures for all kinds of heat installations—boiler settings, oil heaters, vessel linings, driers, kilns, metallurgical furnaces.

Capsule comments to complete our story:

1. Walls and arches feature "built in" stability; any portion can be removed for replacement without weakening adjacent areas. Design provides for thermal expansion.
2. Construction is air tight; heat losses are reduced. Maximum efficiency can be maintained and fuel used to full advantage.
3. Unit suspension permits flexible design, eliminates cumulative loading.
4. B-L engineers co-ordinate enclosure requirements with problems of temperatures, types of firing equipment, and slagging and erosion possibilities.

Write today for more information.

Punished by severe operating conditions, this wall illustrates how quickly and easily repairs can be made.


Worn section of wall. Damaged tile are chipped out, adjacent areas untouched.
New tile ready to be set in place. Unit-suspension avoids cumulative loading.
Ready to go. Many Bigelow installations have records of years of service without any "down time" for repairs.

PIONEERS OF SUSPENDED CONSTRUCTION FOR INDUSTRIAL FURNACE ENCLOSURES . . .

BIGELOW-LIPTAK

Unit-Suspended Walls & Arches

BIGELOW LIPTAK Corporation

SUBSIDIARY OF A. P. GREEN FIRE BRICK CO.

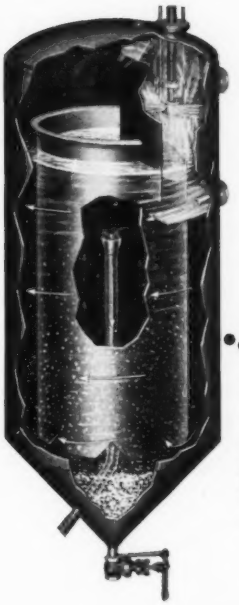
CURTIS BUILDING • DETROIT 2, MICHIGAN

IN CANADA

BIGELOW-LIPTAK OF CANADA, LTD., TORONTO, ONTARIO

DETROIT · CHICAGO · NEW YORK · SEATTLE · SALT LAKE CITY · PHILADELPHIA · MINNEAPOLIS · CLEVELAND · CINCINNATI · PITTSBURGH · SAN FRANCISCO
DENVER · OMAHA · KANSAS CITY, MO. · VANCOUVER, B.C. · HOUSTON · ST. LOUIS · ST. PAUL · BUFFALO · ATLANTA · TULSA · BOSTON · LOS ANGELES

Safe UNIFORM BOILER FEED WATER



Fast, Efficient Water Treatment and Low Chemical Cost with this .....

EXCLUSIVE DESIGN

Infilco Hot-Flow® Softener tank is divided into two compartments of equal volume. Chemicals and heated raw water are mixed in the upper annular section above a stilling plate. Chemical reaction is completed as the mixed chemicals and water flow slowly around and downward in the annular section. At the bottom, treated water separates from the precipitate and rises in the central cylindrical uptake to the takeoff, while the sludge settles to the bottom of the tank.

WATER CONDITIONING AND WASTE TREATING EQUIPMENT

INFILCO

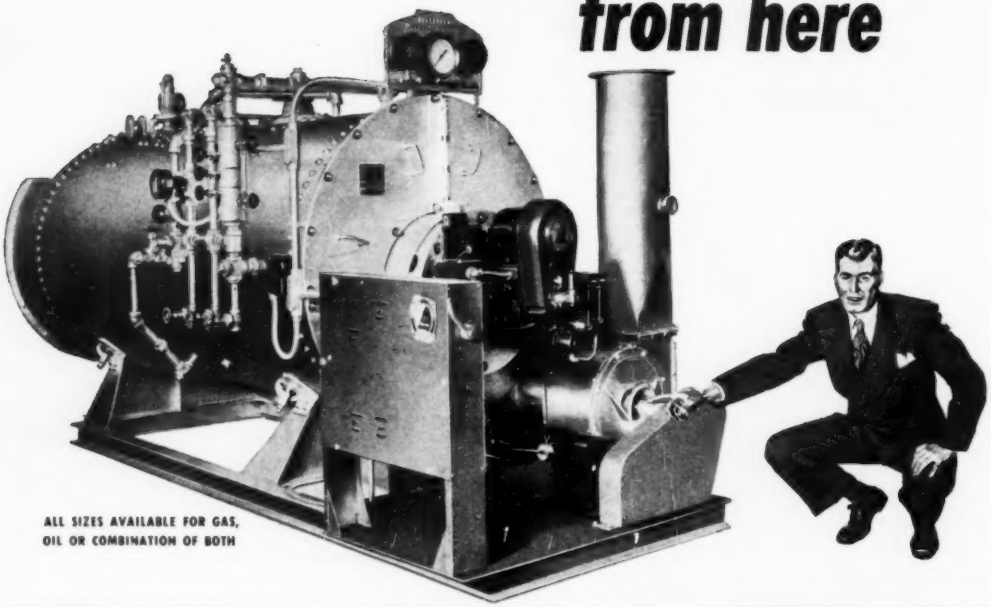
FIRST for Over FIFTY YEARS

Write or Call nearest Field Engineer or Chicago Headquarters

Atlanta, Baton Rouge, Boston, Buffalo, Cleveland, Columbus, Ohio, Dallas, Denver, Detroit, Edgefield, S. C., El Paso, Houston, Indianapolis, Los Angeles, Minneapolis, New York City, Omaha, Orlando, Fla., Pittsburgh, Philadelphia, Salt Lake City, St. Louis, San Diego, San Francisco, Seattle, Tulsa

INFILCO INC. • 325 WEST 25TH PLACE • CHICAGO 16, ILLINOIS

WHY....PREFERRED'S DRAFT *is pulled through from here*



ALL SIZES AVAILABLE FOR GAS, OIL OR COMBINATION OF BOTH

PULL-THROUGH DRAFT, pioneered by Preferred, is one of several features which contribute to the extra efficiency, safety, and economical installation of Preferred Unit Steam Generators.

Preferred's Induced Draft *pulls* the hot gases of combustion through the four passes. It completely eliminates the need of erecting an expensive stack . . . assures the exact amount of air for perfect combustion regardless of atmospheric conditions . . . and prevents the products of combustion from being forced into the boiler room.

Induced Draft tends to keep the flue passes clean of the solid products of combustion. A still-air trap permits the solids to drop into a clean-out compartment, from which they may be easily removed.

Air is drawn through ports in the combustion chamber refractory lining, thereby pre-heating the air and cooling the refractory.

The electric motor is smaller . . . the fan quieter . . . because *induced* gas flow is smoother. The air is drawn gently into the combustion chamber, thereby aiding ignition. The burner won't ignite before the fan starts; gas passes are thoroughly purged prior to ignition.

These many benefits of pull-through draft are the result of Preferred's policy of progressive engineering and design improvement . . . a policy of producing the best possible steam generating plant.

Write for your copy of Bulletin 1000-E. It describes in detail the features of the Preferred Unit Steam Generator. Ask also for the revealing, non-advertising booklet, "Dividends from Your Power Plant."

ADDITIONAL FEATURES OF PREFERRED UNIT STEAM GENERATOR

1. Fully Automatic Operation—even with Bunker C or No. 6 oil.
2. Preferred Oil Burner—exclusive aid to perfect combustion, built especially for this unit.
3. Four-pass, Down-Draft Gas Travel—results in maximum heat absorption.
4. 80% Minimum Thermal Efficiency—proved and guaranteed.
5. Low Maintenance—the result of over 27 years of combustion engineering experience.
6. Full Range of Sizes—from 20 to 500 H.P., pressures of 15 to 200 lbs. Two-pass Units in 20 and 30 H.P. and 15 lbs. pressure.

PREFERRED UTILITIES MANUFACTURING CORPORATION, 1860 Broadway, New York 23, N. Y. PR-159

PREFERRED UTILITIES MFG. CORP.

HAMPERED by *Icicles* too

Icicles here are just as much an obstacle as they can be in welded pipe. Both have their disadvantages and prevent the most efficient and satisfactory service. Without the use of backing rings (and they, too, cause "humps"), pipe welds form metal "icicles" quite like these. The patented Mitchell-Westport Joint, the Controlled, Two Stage Welded Joint, prevents the "icicles" on the interior of the pipe, thus permitting smooth, unimpeded flow. The Westport Method consists of a seal and anchor weld that completely prevents constriction of the inside diameter at the joints without sacrificing maximum bondage or strength. For a detailed description, write for our bulletin, "Something New in Welding." While our shop prefabricated piping can be made with any type of weld, after you've read our bulletin, we believe you will specify the Westport Method for thicker walls and higher pressures and temperatures.

1899 · OUR 50th YEAR · 1949

REPRESENTATIVES IN BOSTON, NEW YORK, CLEVELAND, MOBILE AND HAVANA

WESTPORT JOINT

(PATENTED)

W. K. MITCHELL & CO., INC.

2944 ELLSWORTH STREET

PHILADELPHIA 46, PA.

SINCE 1899

MITCHELL

PIPING FABRICATORS AND CONTRACTORS

Automatic Cure for Plugging of Travelling Intake Screens

Simple FOXBORO Control System operates screen whenever suction level drops . . .

HERE'S AN EASY, inexpensive way to make sure that your condenser won't overheat if excessive refuse causes sudden plugging of the travelling screen.

Foxboro Travelling Screen Control supplements periodic screen-timing with a "judgment" that's almost human. By continuous measurement of water level on each side of the screen, this sensitive control system independently starts the cleaning action whenever a predetermined safe differential is exceeded. When correct levels are again restored, it automatically shuts down screen and spray motors. In case of unusually severe fouling of the screen, the controller can also operate a warning signal.

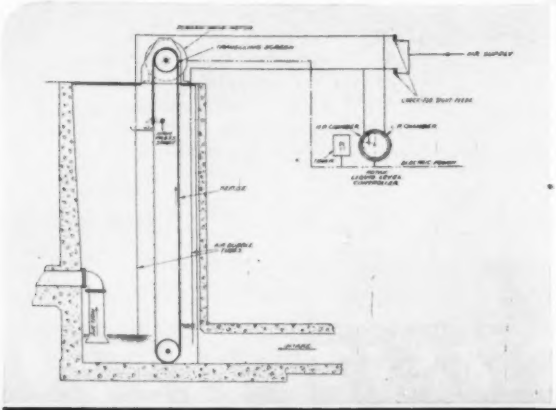
Write for complete information on Foxboro Travelling Screen Control and Bulletin 184-4 containing details of Foxboro Rotax Controllers. **The Foxboro Company, 252 Neponset Ave., Foxboro, Mass., U.S.A.**

ROTAX

Liquid Level Controller

The "heart" **of Foxboro Travelling Screen Control. An extremely simple, positive-operating controller that translates level differential into operation of motors. In addition, it can operate a warning horn or light in case of unusually severe plugging.**

Exclusive Rotax features include: **positive electrical contact; special lock-up circuit which eliminates chattering of control relays; constant brush pressures; self-cleaning platinum contact surfaces; easy setting of control point; and freedom from maintenance.**



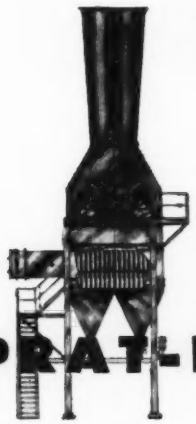
SCHEMATIC DIAGRAM, left, shows simplicity of Foxboro Travelling Screen Control System. Water level differential through the screen is continuously measured by bubble tubes. The Foxboro Rotax (electric) Controller starts and stops the screen and spray motors, as required to maintain safe differential.

FOXBORO
REG. U. S. PAT. OFF.

RECORDING · CONTROLLING · INDICATING
INSTRUMENTS

COORDINATION

Prerequisite to Induced Draft Efficiency



Coordination of the components is as important to the efficiency of Induced Draft Equipment as it is to the smooth harmony of a ballet.

Beside the disadvantage of higher cost when installed separately—unit by unit—the non-integrated breeching, I.D. Fan and Stack, in many cases, operate at sub-standard efficiency due to lack of over-all unified engineering.

Prat-Daniel research has evolved an induced draft system that eliminates this problem . . . provides the absolute ultimate in fuel efficiency.

Result—the well-known Thermix Fan Stack! Inlet Breeching, Fan and Stack combined in a single, integrated draft-producing unit that is unbeatable for high level performance.

From boiler outlet to atmosphere, depend on Thermix Fan Stacks to maintain predetermined, constant draft with full efficiency for your boiler.

Our project engineers will be glad to show you the advantages of Thermix equipment. Write for a complete catalog on your company letterhead. *All inquiries should be directed to*

Project & Sales Engineers

THE THERMIX CORPORATION

First National Bank Bldg. **Greenwich, Conn.**

(Offices in 28 principal cities)

Canadian representative: **T. C. CHOWN, Ltd., 1440 St. Catherine St. W., Montreal 25, Quebec**

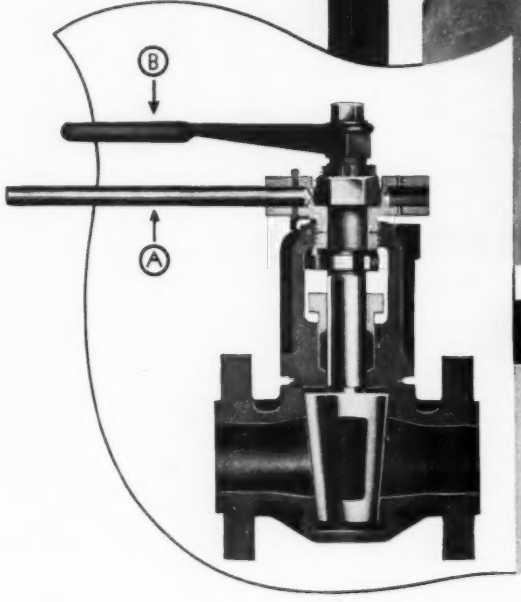
PRAT-DANIEL CORPORATION

Manufacturers of Thermix Equipment

EAST PORT CHESTER, CONN.

"Instant, Stick-Proof Operation *at all Times, Under all Conditions*"

with HOMESTEAD Lever-Seald Valves



NOTE THESE OUTSTANDING FEATURES

1. Instant Stick-proof operation.
2. Quarter-turn fully opens or closes.
3. Positive seal without lubrication.
4. Seating surfaces always protected in both open and closed positions. Corrosion practically eliminated.
5. Unobstructed straight-line fluid flow.
6. All operating parts protected from damaging effects of service conditions and weather.

A powerful lever-and-screw device—built into each valve—prevents sticking and assures positive action at all times and under all conditions. Corrosive or viscous fluids, temperatures as low as 40° below Zero or as high as 1120° F., pressure or other adverse conditions that ordinarily cause valve failures, cannot affect the operation of Homestead Lever-Seald Valves.

Homestead Lever-Seald Valves operate faster too, 16 to 28 times faster than screw-stem-type valves. Seating pressure is first relieved with the lower lever "A" just enough to overcome friction. Then a quarter-turn of the upper lever "B" fully opens or closes the valve. Full seating pressure is again applied with the lower lever to make a positive, leakless seal.

Homestead Lever-Seald Valves can be furnished in combinations of metals and alloys to suit your requirements in sizes 1½" to 10", for pressure from vacuum to 1500 pounds.

Write today for full information and copy of Section 3, Valve Reference Book No. 39.

HOMESTEAD VALVE MANUFACTURING CO.

P. O. BOX 210 CORAOPOLIS, PA.

Accept no less than the FULL LINE!

Whatever the conditions: Extreme temperatures . . . . extreme pressures . . . . steady flow or shock service . . . . corrosion resistance . . . . product purity.

Whatever the material: Forged carbon steel . . . . wrought iron . . . . carbon or chrome moly . . . . Stainless 304, 347, 316 . . . . Monel . . . . Nickel . . . . Inconel . . . . Aluminum . . . . other usual industrial materials.

Whatever the size or weight: Forge-formed fittings in the entire size range from ¾" all the way to 30" (or larger!): in all the usual or special weights necessary for *any* service condition; with a companion range of seamless forged and forge-rolled flanges of every type, in *all* ASA sizes and pressure series, or beyond, as large as 96" diameter.

Whatever your requirement: Taylor Forge provides the most complete line. Accept no less!

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS General Offices & Works: Chicago 90, Ill. (P.O. Box 485) Eastern Plant: Carnegie, Pa. Western Plant: Fontana, Calif. • District Offices—New York: 50 Church Street • Philadelphia: Broad Street Station Bldg. • Pittsburgh: First National Bank Bldg. • Chicago District Sales: 208 S. LaSalle Street • Houston: City National Bank Bldg. • Los Angeles: Subway Terminal Bldg.

Do your piping systems needs any fitting or flange problems for you? . . . . . If the information you need goes beyond the simple return of the coupon at the right, please write us fully. You will receive a prompt and detailed reply.

☐ **Who is my nearest Taylor Forge Distributor?**

☐ **Put my name on your mailing list to receive informative literature.**

Name _____

Position _____

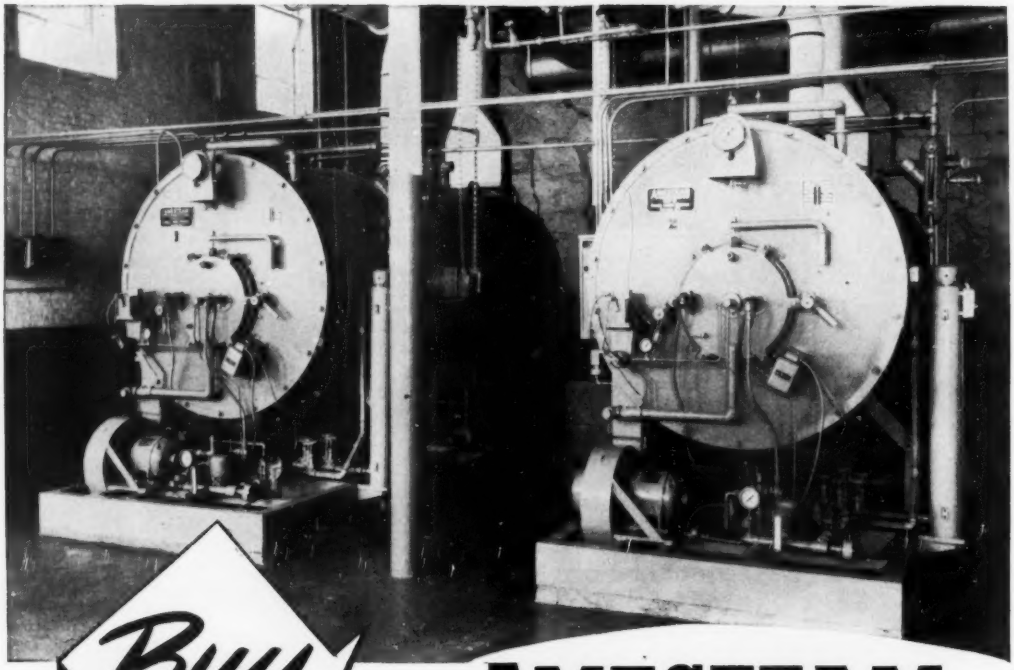
Company _____

Street Address _____

City _____ **Zone** _____ **State** _____

501-0349 **Mail to Taylor Forge & Pipe Works, P.O. Box 485, Chicago 90, Illinois**

WHAT'S YOUR STEAM PROBLEM?



Buy

AMESTEAM GENERATOR

Do you want — a dependable, quick steaming unit? Minimum installation expense? Economical operation?

- **AUTOMATIC OPERATION**—from a cold boiler to full operating pressure in only a few minutes — just press the button.
- **ECONOMICAL OPERATION**—guaranteed 80% efficiency. Fuel consumed only as steam is used. Combination Units available for quick change-over to either oil or gas to meet changing fuel availability.
- **ACCESSIBILITY**—rear flue cover and baffle easily removed for cleaning and inspection. All equipment installed in easy-to-get-at locations.

STANDARD EQUIPMENT INCLUDES: In addition to the minimum equipment usually furnished with Units of this type, our standard unit for over 15# design steam pressure regularly includes:

Condensate Tank	**Blow-off Valve**
Feed Pump Unit	**Injector**
Main Steam Valve	**Necessary Refractories**
Insulation and Metal Jacket	

Remember these are not extras to be added to our bid—they are standard equipment.

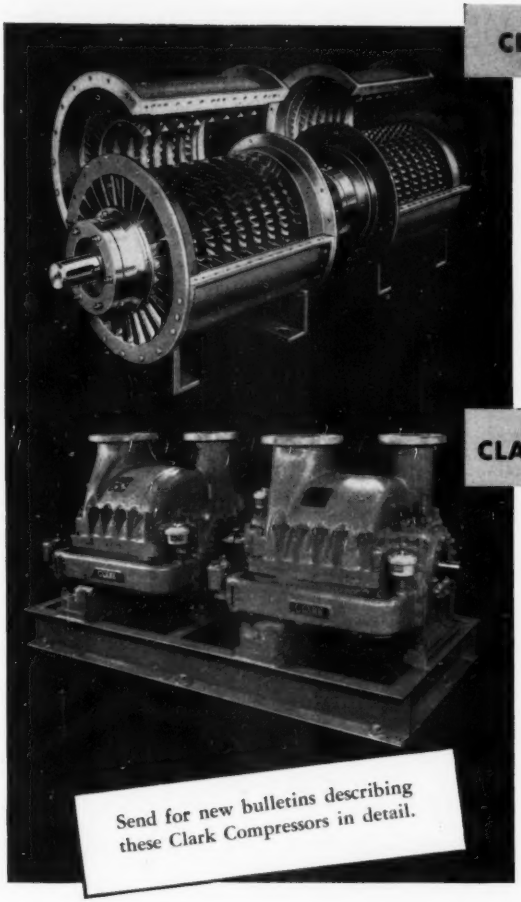
With your AMESTEAM Generator, you get everything you need except fuel tank, piping to boiler, wiring from power lines to boiler, and a breeching or vent pipe.

AMES IRON WORKS Oswego, N.Y.
Builder of Better Boilers Since 1848

Write **for the AMESTEAM Generator Bulletin A-803**

NEW CLARK COMPRESSORS

FOR HIGH PRESSURES AND LARGE VOLUMES



Send for new bulletins describing these Clark Compressors in detail.

CLARK *Axial-Flow* COMPRESSOR

● Clark Axial-Flow Compressors are high-capacity, high-efficiency machines, especially valuable in the volume range of 20,000 to 300,000 CFM. Adiabatic efficiencies up to 85 per cent are obtainable in industrial units built to standard specifications. Efficiencies up to 90 per cent are obtainable on special order.

These compact, lightweight units are suitable for electric motor, steam turbine or gas turbine drive. Clark gas turbine drives, reflecting latest developments in research and design, are built on order to customer specifications.

CLARK *Centrifugal* AIR COMPRESSOR

● Shown here are two Clark No. 2 Centrifugal Air Compressors in series, which deliver approximately 6000 CFM of free air at 110 psig pressure. Both cases of five (5) impellers each are coupled for direct drive by one 1450 HP steam turbine operating at 9400 RPM.

This Multi-Stage Clark Centrifugal Compressor of improved design is compact in size, light in weight, and dependable in operation.

Clark Bros. offer a complete line of standard, high capacity centrifugals for air or gas for volumes up to 120,000 CFM and pressures up to 900 psig. A number of Clark Centrifugal Air Compressors for 100 psig duty have been built with power requirements from 1400 to 22,000 BHP. Also several sizes have been built for the compression of hydro-carbons, oxygen and sulphur dioxide for pressures up to 450 psig.

CLARK BROS. CO., INC., OLEAN, NEW YORK

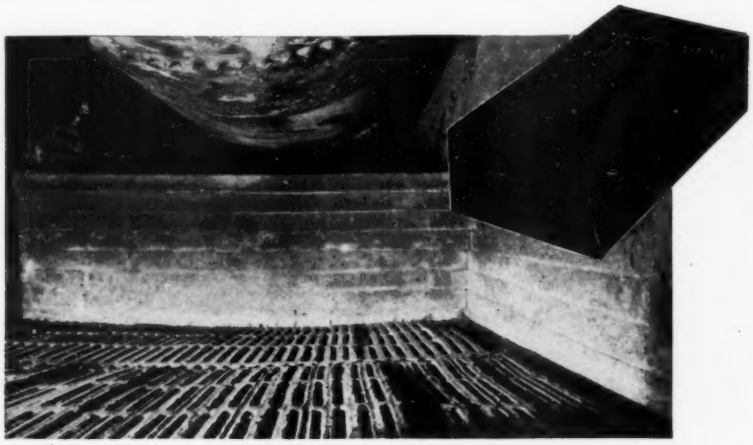
BIRMINGHAM, ALA. • BOSTON • CHICAGO • DETROIT • HOUSTON • LOS ANGELES • NEW YORK • SALT LAKE CITY • SAN FRANCISCO
TULSA • WASHINGTON • LONDON • PARIS • BUCHAREST, RUMANIA • CARACAS, VENEZUELA • BUENOS AIRES, ARGENTINA

CLARK

ONE OF THE DRESSER INDUSTRIES

Whatever type of Compressor you need, *CLARK MAKES IT*

For Longer Life in Boiler Furnaces Use Norton Company's CRYSTOLON BRICK



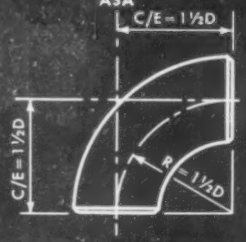
For longer life in boiler furnaces power engineers specify Norton Company's CRYSTOLON Brick because of these qualities: (1) high refractoriness, (2) chemical stability, (3) great strength at elevated temperatures, (4) remarkable resistance to abrasion, (5) greater resistance to spalling than any other refractory material, (6) strong resistance to both the chemical and physical action of molten slag. For proof we offer the above illustration showing CRYSTOLON Brick still in excellent condition after 12 years of trouble-free service in a school boiler.

NORTON COMPANY - Worcester 6, Mass.

CRYSTOLON—Trade-mark Reg. U. S. Pat. Off.

Improvements and economies in welded piping result from this *Variety* of MIDWEST ELBOWS

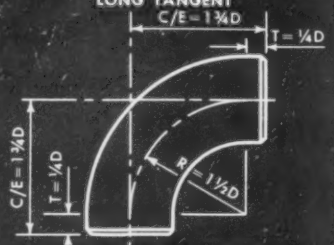
1 LONG RADIUS ASA



SIZES: ¾″ TO 24″, INCLUSIVE

Dimensions conform to applicable size range of American Standard for Butt-Welding Fittings, ASA B16.9. Radius and center-to-end dimension equal 1½ times nominal pipe size.

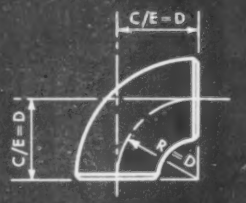
2 LONG RADIUS LONG TANGENT



SIZES: 2″ TO 20″, INCLUSIVE

Same radius as ASA Elbows but with long integral tangent on each end — an exclusive Midwest feature that saves time and pipe. No price increase over ASA Elbows.

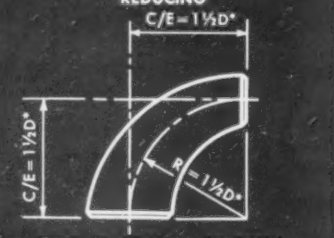
3 SHORT RADIUS



SIZES: 1″ TO 30″, INCLUSIVE

Where space limitations prevent use of ASA Elbows or Midwest "Long Tangent" Elbows shown above at right, these short turn elbows without tangents are recommended.

4 LONG RADIUS REDUCING



SIZES: 2″ TO 12″*, INCLUSIVE

Midwest Reducing Elbow takes the place of a straight elbow and a reducer. It saves more than one-third of the welding and improves both design and appearance.

SYMBOLS { *C/E—Center-to-End Dimension; T—Length of Tangent; D—Nominal Pipe Size; R—Radius; *D—Dimension is for larger Pipe Size*

The *variety* of Midwest Welding Elbows is particularly important because of the exceptional latitude in design and economy in erection that it provides. For example, the Midwest Long Tangent Elbow permits faster, easier, more accurate lining up with pipe . . . removes weld from point of maximum bending stress . . . often eliminates a short nipple and its extra weld. Slip-on flanges are easily used with minimum change in flange and fitting.

This "Variety" is only one of several reasons why many users prefer Midwest Welding Elbows.

Only MIDWEST offers this VARIETY

MIDWEST WELDING FITTINGS Improve Piping Designs and Reduce Costs

90° ELBOWS

REDUCING 90° ELBOWS — 45° ELBOWS

LAP-JOINT STUB ENDS — REDUCERS

CAPS — SADDLES — SLEEVES

RETURN BENDS — TEES

LATERALS — CROSSES

REDUCING-ON-RUN TEES

SHAPED NIPPLES — FLANGES

MIDWEST PIPING & SUPPLY CO., Inc.

Main Offices: 1450 South Second Street, St. Louis (4), Mo.

* Sales Offices: New York (7), 30 Church St.

Chicago (3), 79 West Monroe St. • Los Angeles (33), 520 Anderson St. • Houston (2), 229 Shell Bldg. • Tulsa (3), 533 Mayo Bldg. South Boston (27), 426 First St. • Distributors in Principal Cities.

Specify CMH EXPANSION JOINTS

...for compact, dependable pipe-line expansion control

Conservatively rated, precision-made CMH Expansion Joints offer new highs in dependability and trouble-free service. Compact corrugated assemblies cannot leak; there is no maintenance. Just install CMH Expansion Joints and forget about them.

CMH Expansion Joints are available in two types—Controlled-Flexing Joints with precision-mated control rings for higher pressures; Free-Flexing Joints for lower pressures. Both types are furnished in stainless steel or copper. Special expansion joints can be furnished for unusually high pressure ratings.

On your next job, whether it's a new installation or replacement of obsolete equipment, specify CMH Expansion Joints. Bulletin EJ-47, available on request, incorporates data for guidance in selecting the CMH Expansion Joints for your requirements. Both standard flanges and welded ends are furnished.

You'll find CMH Expansion Joints are simple to install.

"FLEXON" identifies CMH products, which have served industry for more than 45 years.

"the science of FLEXONICS . . ."the controlled bending of thin metals for use under varying conditions of temperature, pressure, vibration and corrosion" . . . is exemplified in the basic products of Chicago Metal Hose Corporation.

Write today for Bulletin EJ-47. Have specifications and operating data for CMH Expansion Joints at hand for ready reference.

CMH EXPANSION JOINTS

CHICAGO METAL HOSE CORPORATION

Expansion Joint Division • Maywood, Illinois

Plants at Maywood, Elgin and Rock Falls, Illinois

In Canada: Canadian Metal Hose Company, Limited, Brampton, Ontario

You're sure to have

Better, Safer

boiler water level supervision

with **Reliance EYE-HYE**

Remote Indication Saves Time—Increases Efficiency

YOU SAVE precious seconds—often many dollars—by reading boiler water levels in the EYE-HYE, without tedious dangerous climbing to high boiler gages. An EYE-HYE for each boiler, mounted on your panel board, gets a glance every time instruments are checked—a sure way to catch wasteful or hazardous feed water conditions.

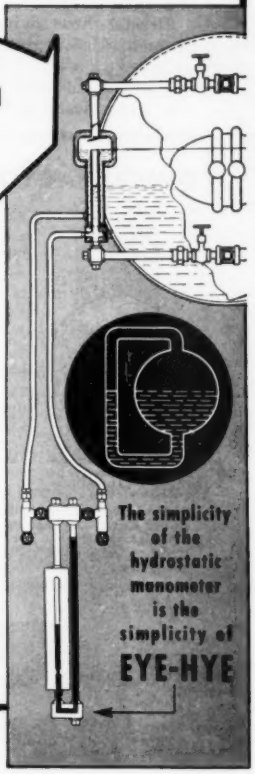
Brightly illuminated green fluid arrests every operator's eye. EYE-HYE's accuracy and dependability resulting from its simple hydrostatic principle and rugged construction are praised by thousands of engineers. It can't be tampered with in service; easy to install; practically no maintenance. Write or call your nearest Reliance Representative.

Reliance UNITEMP—complete temperature equalizing unit—furnished with each EYE-HYE

UNITEMP maintains an even temperature in both hydrostatic legs, thus assuring EYE-HYE's accuracy. It's furnished as original equipment with each EYE-HYE—a *complete unit*, ready to install with small expense for fittings.

EYE-HYEs for all types of service

EYE-HYE models cover all pressure situations, from lowest (even at vacuum) to as high as 2500 psi. Checking levels in auxiliary vessels such as feed water heaters and surge tanks is made faster and more convenient by models especially adapted to that purpose, with graduated face plates if you want them. One EYE-HYE model measures liquid level variations as large as *12 feet.*



BOILER SAFETY DEVICES since 1884

Reliance

THE RELIANCE GAUGE COLUMN CO. • 5902 CARNEGIE AVENUE • CLEVELAND 3, OHIO

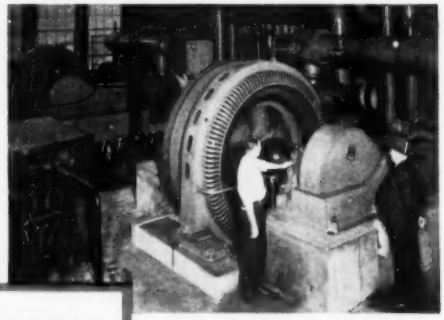
How to carry
MORE POWER
over your lines

Power factor improvement—just one of the operating advantages of E-M Synchronous Motors—removes a burden from your power line. Synchronous Motors, in addition to driving their connected mechanical load, supply magnetizing current to offset the low power factor of induction motors and other equipment. Large-power Synchronous Motors may often be added to existing lines and transformers without raising kva to a level requiring larger feeders, transformers and control equipment.

Because transformers and distribution lines are limited in their kilowatt capacity by the total kva they must carry, Synchronous Motors—by furnishing leading kilovars—replace lagging kilovars in the line with kilowatts for useful work. Providing your own leading kilovars, rather than buying them from the power company, usually results in reduced power billing. As a further benefit, steady voltage is maintained on a higher level than would be the case at a lower power factor.

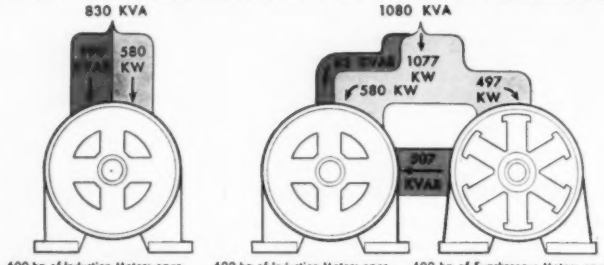
Besides these savings and advantages, E-M Synchronous Motors give you constant speed, wide range of speed ratings, high stability under voltage dips. It's this double-duty performance that makes them the most efficient drive in industry.

● One of five E-M Synchronous Motors applied to air conditioning fans to improve power factor in a large engine gear plant in Indiana. The motors are 60 hp, 1200 rpm.



● Both of these 500 hp, 180 rpm Synchronous Motors operating air compressors at Motor Products Corp., Detroit, Mich., feature power factor correction at 0.7 leading pf.

POWER FACTOR MAKES A DIFFERENCE



600 hp of Induction Motors operating at 0.7 lagging power factor —580 KW, 830 KVA, 590 KVAR.

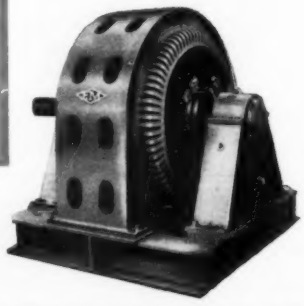
600 hp of Induction Motors operating at 0.7 lagging power factor —580 KW, 830 KVA, 590 KVAR.

600 hp of Synchronous Motors operating at 0.7 leading power factor—497 KW, 711 KVA, 307 KVAR.

In the system operating at low power factor the lagging kilovars carried by the line may equal or exceed the kilowatts doing useful work.

Addition of Synchronous Motor drives to this system permits doubling the horsepower capacity, with only a 30% increase in kva.

Write for
"The ABC of Power Factor"

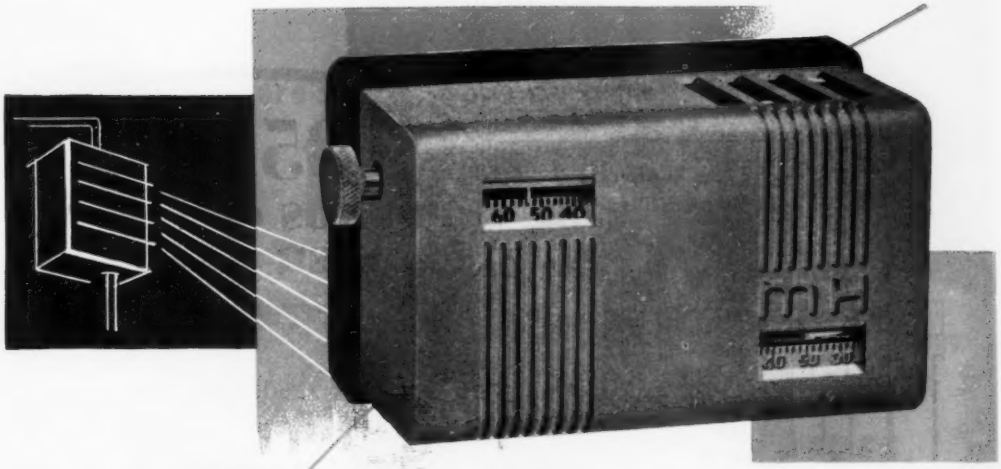


A2033

Send for 20-page illustrated booklet, "The ABC of Power Factor."

E-M

ELECTRIC MACHINERY MFG. CO.
Minneapolis 13, Minnesota



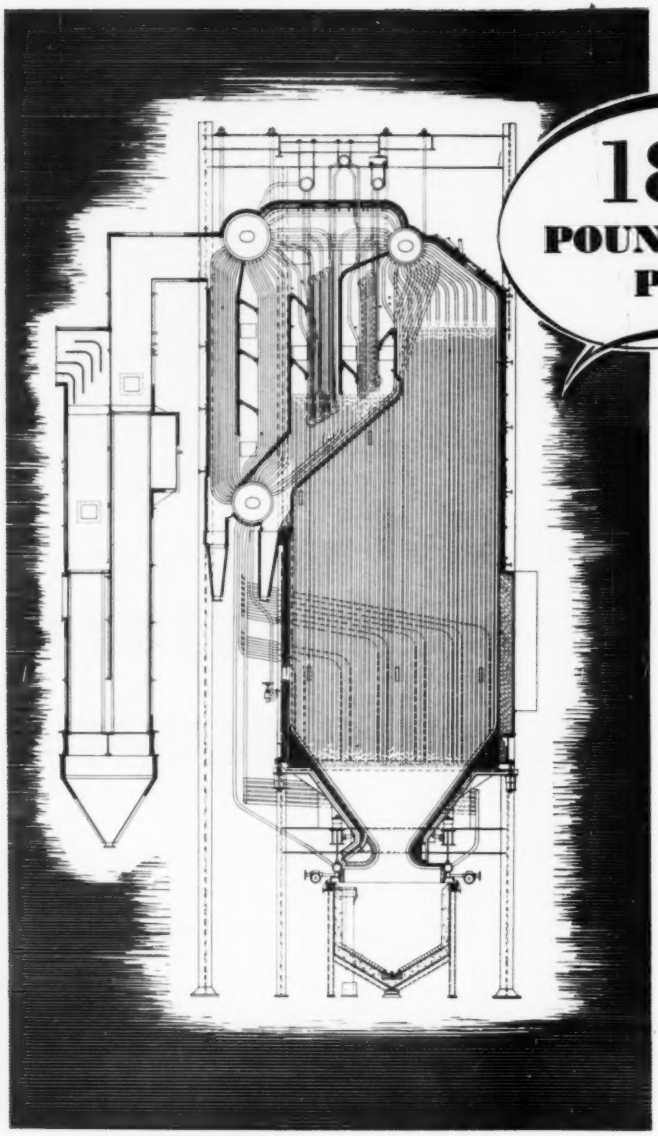
use the Best.... for your unit heaters!

THE HONEYWELL LINE VOLTAGE THERMOSTAT

HERE'S the finest line voltage thermostat ever built. Whether you use it for steam or hot water or gas fired unit heaters, you'll find the Honeywell TA42 thermostat more accurate, more sensitive and more dependable than any competitive control. It's a rugged instrument built for years of service. In addition to use with unit heaters, the TA42 is designed to fit all applications involving use of line voltage thermostats. Insist on the Honeywell TA42. You'll find the best always gives you best results. Minneapolis-Honeywell, Minneapolis 8, Minnesota. In Canada: Leaside, Toronto 17, Ontario.

MINNEAPOLIS
Honeywell
CONTROL SYSTEMS

73 BRANCHES FROM COAST TO COAST WITH SUBSIDIARY COMPANIES IN: TORONTO • LONDON • STOCKHOLM • AMSTERDAM • BRUSSELS • ZURICH • MEXICO CITY



185,000
POUNDS OF STEAM PER HOUR

Purchaser—
An Eastern Utility

Number of Steam Generators 4

Pounds of Steam/Hr. . 185,000

Design Pressure . . . . . 950 lbs.

Operating Pressure . . . 875 lbs.

Steam Temperature . . 885° F.

Heating Surface—
Erie City Boiler
13,300 Sq. Ft.
Erie City Water Walls
6,460 Sq. Ft.
Erie City Air Preheater
28,000 Sq. Ft.

Final Exit Gas Temp. . 328° F.

Method of Firing
Pulverized Coal

STEAM POWER PLANT EQUIPMENT

Complete Steam Generators • Type C 3-Drum Boilers • Type VL 2-Drum Boilers • The "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • Coal Pulverizer • Underfeed and Spreader Stokers • Welded Pressure Vessels for the Process Industries.

ERIE CITY
SINCE 1840

ERIE CITY IRON WORKS • ERIE, PA.

Here's some good data on

Power Plant Piping

New, revised edition of Bulletin 10 —it's FREE, yours for the asking

● This authoritative brochure should be in the hands of every man concerned with the piping requirements of a modern high-pressure, high-temperature steam station. For here is practical data and information that will simplify your selection and use of power piping and will help you obtain greater efficiency and better results from its application.

The 30-page "Technical Section" of this book includes information on working stresses, creep properties, pipe bends; weights, dimensions, properties of pipe and tubes and other important data that you can use to advantage.

Keep yourself up-to-date on power plant piping — send for a copy of this book, NOW, while you have it in mind. The coupon is attached for your convenience.

National Tube Company
Frick Building, Pittsburgh 19, Pa.

Please send me your new Bulletin No. 10, "Power Plant Piping."

Name.....

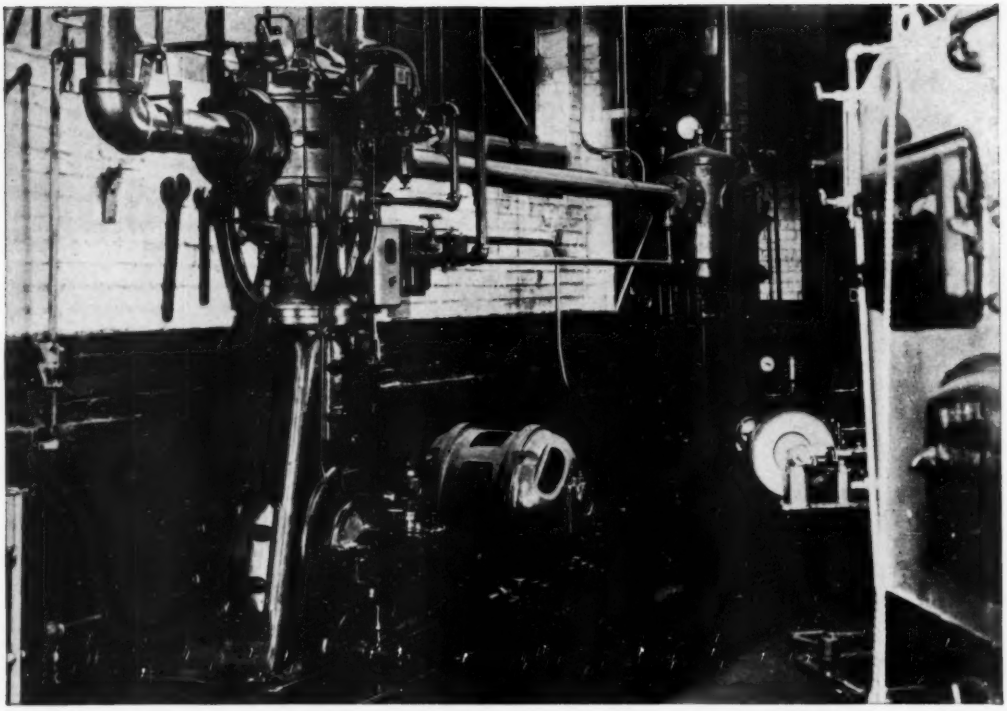
Company.....

Address.....

NATIONAL TUBE COMPANY
PITTSBURGH, PA.
(TUBING SPECIALTIES DIVISION)
COLUMBIA STEEL COMPANY, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

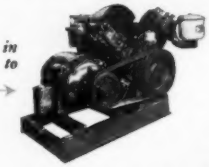
UNITED STATES STEEL



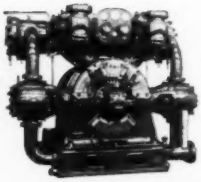
SAVE VALUABLE SPACE WITH THE EFFICIENT

JOY WG-9 HEAVY DUTY AIR COMPRESSOR

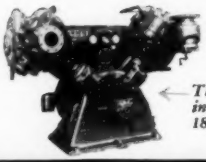
The vertical design and small base of the JOY WG-9 Compressor mean great savings in valuable floor space. Built in eleven sizes from 153 to 822 CFM, the WG-9 is designed for continuous heavy-duty service... features the exclusive JOY "Dual-Cushion" valves for top efficiency and lowest-cost operation. ● JOY builds the most modern compressors available for either centralized or decentralized air supply—*write for Bulletin.*



The JOY WL-80, in nine sizes from 81 to 590 CFM.



The JOY WN-114, in single or twin units from 1092 to 7312 CFM.



The JOY WN-112, in sizes from 378 to 1828 CFM.

Consult a Joy Engineer

W&D 12049

JOY MANUFACTURING COMPANY

GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Overcoming Scale and Slime...

For More Efficient Heat Transfer and Longer Tube Life

Accumulations of foreign matter in condenser and heat exchanger tubes are generally universal and troublesome. In main condensers this cuts down heat transfer, causing a drop in condenser vacuum which may waste many tons of precious fuel. Such auxiliary equipment as hydrogen coolers and lube oil coolers, generally have adequate capacity for maintaining sufficient heat transfer in spite of accumulation of foreign matter.

Slime and Marine Growths

Despite high water velocities, algae and bacteria may accumulate on the tube walls as tenacious slime. This condition varies with the seasons and with the nature of pollution from sewage and industrial wastes.

The living organisms in slime give off acid substances which play an important part in the corrosion of metals. Slime also makes it easier for barnacles, mussels and other marine organisms to attach themselves to the tube walls, tube sheets and other surfaces.

Marine Organisms

The high water velocities in the main condensers usually prevent larger marine organisms from attaching themselves to the tube walls. However, there are cases where water velocity is lowered because of operation on one pump during colder weather. Certain organisms may then become firmly attached to the tube walls, and remain in place even after the unit is switched to two pumps, with corresponding increase in water velocity. Once established, under favorable conditions, organisms may grow at a surprising rate.

In other cases, marine organisms attached to water boxes or piping leading into the condensers may be knocked loose by increased velocity and swept into the condenser, blocking some of the tubes partially or completely. Here there is a tendency for larger marine organisms to accumulate and for more slime to build up.

In estuaries where salinity of the water varies with the seasons, spring rains sometimes change brackish (mixture of salt and fresh) to predominantly fresh water. As a result, mussels and barnacles may be killed and their shells drawn into the condenser tubes.

Barnacles, oysters and mussels, lodged in the tubing, may deflect cooling water against the tube wall, causing impingement corrosion. After death, their decomposing tissues form substances which attack the protective film.

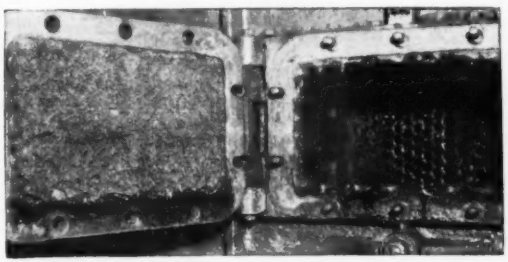
Objectionable Scale Formation

While some protective scaling is desirable on condenser and heat exchanger tubing, excessive scale seriously reduces the rate of heat transfer. Heavy mineral scales are frequently encountered in evaporators and may form at rates as high as .1 inches per month.

Preventive Measures

The method used to clean condenser tubes depends upon local conditions. One of the more common methods consists of drying out the unit by passing hot air through the tubes while steam is circulated on the other side. Under these conditions algae-type films dry out and peel off. Another method consists of forcing rubber plugs through the tubes by high pressure streams of water. Rotary brushes of fiber or wire are also used. Wire brushes should be used with caution to avoid injury to the protective film.

Chemical cleaning methods include periodic treatment of the circulating water with chlorine, chloramine or hypochlorite solutions. Another practice is to fill up the condenser with chemical solutions and allow it to "soak" for several hours. These procedures must be carried out with care to avoid excessive exposure and injury to protective film.



Accumulation of marine growth on condenser water box and tube sheet in Gulf Coast power plant.

Inhibited acids are also used which are designed to attack the mineral scale, but not the tubes. This method is most successful with carbonacious scales. Silicate and calcium sulphate scales found in some Western and Southwestern areas are more difficult to remove. In some cases, scales are knocked loose by a jet of steam passed through the tubes.

Where heavy scales are troublesome, particularly in evaporators, the tubing, in some cases, is installed in a bowed position. The tubes expand and contract as the temperature of the metal rises and falls, causing them to snap back and forth, thus flaking off the scale.

Sometimes considerable less fouling occurs in the outlet tunnels than in the inlet tunnels of power plants because of the higher temperature of the outgoing water. Where conditions permit, periodic shifting of the direction of water flow helps to reduce fouling to a very marked extent.

Tubes are sometimes scoured by a mixture of sand and water. The amount of cleaning is controlled by the quantity of sand. In some localities there is sufficient sand in the water at all times to keep tubes clean. Excessive naturally occurring sand in the water can, of course, lead to general thinning of the tubes and to rapid impingement corrosion when particles of debris lodged in the tubes deflect the sand-laden water against the tube wall.

Effect of Alloy Composition

Biofouling tendencies vary with the composition of copper-base alloys. In general, copper and its alloys are more resistant to slime and marine growth than are aluminum, steel and concrete. The small amount of copper dissolved in the water retards marine growth. This explains why the more corrosion-resisting alloys such as Cupro Nickel, Duronze* IV (Arsenical Aluminum Bronze), and Aluminum Brass, which dissolve the least, are more susceptible to biofouling than are Admiralty and Copper.

Consult Bridgeport's Laboratory

Bridgeport's Laboratory will gladly help operators get the most out of their tubing from the standpoints of heat transfer, reduced maintenance and long life. Bridgeport manufactures a wide range of corrosion-resistant alloys and the laboratory will make recommendations on the basis of many years of experience and the results of service tests of sample lots of tubing installed under actual operating conditions.

Contact the nearest Bridgeport office for laboratory service and write for 120-page Condenser Tube Manual, containing much corrosion data and information about condenser tube alloys, suggestions for increasing tube life and other valuable tables.

*U. S. Pat. No. 2,093,380

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • *ESTABLISHED 1865*

Mills at Bridgeport, Connecticut, and Indianapolis, Indiana • In Canada: Noranda Copper and Brass Limited, Montreal

HEACON DAMPERS

for unique applications

the two in one damper

provides maximum control

prevents reverse flow

Variations in design of Heacon Dampers are made when specific applications make them necessary. One of the most unique dampers developed for special application is the double duty Heacon Damper here illustrated.

This unit was designed to operate in tandem with two others, for the control of 3,000 h.p. blowers. It is actually a combination of two types: the SVH, seen partially closed through the grill, for regulating flow, and the LH, or leaf type, shown in open position on near side. This LH damper acts as a check valve to prevent reverse flow. Both damper curtains use a common grill and provide maximum control for the blowers.

Heacon Dampers are the answer to many flow control problems. Your problem may be a unique one that can be easily solved by our designs. Why not contact our representatives and let them help you with the solution to your control problem.

FIELD PROJECT ENGINEERS

ATLANTA, GEORGIA
C. E. Johnson & Associate
Bona Allen Building

BOSTON 10, MASS.
Thermix Engineering Co.
88 Broad Street—Room 610

BUFFALO, NEW YORK
Johnston Engineering Co.
1200 Niagara Street

CHARLOTTE 2, N. C.
T. C. Heyward
1408 Independence Bldg.

CHATTANOOGA 2, TENN.
Edgar A. Rogers
Chattanooga Bank Bldg.

CHICAGO 6, ILLINOIS
Cochrane Engineering Corp.
309 West Jackson Boulevard

CINCINNATI 2, OHIO
Ellman Equipment Co.
1101 Fed. Reserve Bank Bldg.

CLEVELAND 15, OHIO
H. W. Kaiser Company
1836 Euclid Avenue

DETROIT 2, MICHIGAN
Metrol Company
5538 Cass Avenue

HOUSTON, TEXAS
J. A. Rossiter Company
P. O. Box 1095

KANSAS CITY, MISSOURI
F. W. Hay & Company
2734 Cherry Street

LOS ANGELES, CALIF.
A. W. Anderson
164 So. Central Avenue

MINNEAPOLIS 2, MINN.
Hoyt A. Sevey
514 South 9th Street

MONTREAL 25, CANADA
T. C. Chown, Ltd.
1440 St. Catherine St., West

NEW HAVEN 5, CONN.
Daniel Smerling
P. O. Box 1169

NEW ORLEANS, LA.
Arthur C. Hays
1221-23 Carondelet Bldg.

NEW YORK 7, N. Y.
Parry Engineering Co.
154 Nassau St.

PHILADELPHIA 3, PA.
Thermix Engineering Co.
1003 Broad St. Station Bldg.

PITTSBURGH 19, PA.
Herr-Harris Company
545 William Penn Way

PORTLAND 4, OREGON
Lee & Freeman, Inc.
Room 302, Governor Bldg.
408 S. W. 2nd Avenue

RICHMOND 1, VA.
Frank Howell Company
Room 412, American Bldg.

ROCHESTER 4, N. Y.
Johnston Engineering Co.
31 Gibbs Street

ST. LOUIS 8, MISSOURI
Economy Equipment Co.
4526 Olive Street

SALT LAKE CITY 9, UTAH
The Lang Company
267 West First South
P. O. Box 479

SAN FRANCISCO 4, CALIF.
S. Herbert Lanyon
58 Sutter Street

SCHENECTADY 8, N. Y.
D. R. Whipple
6 Morris Avenue

SEATTLE 4, WASH.
Lee & Freeman, Inc.
1550 First Ave., South

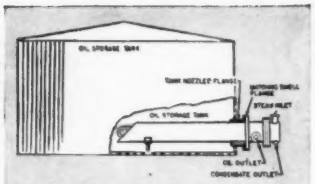
WASHINGTON 11, D. C.
T. W. McGuire Company
137 Kennedy Street, N.W.

HEACON

THE THERMIX CORPORATION

Project & Sales Engineers

FIRST NATIONAL BANK BLDG. GREENWICH, CONNECTICUT



PARACOIL TANK SUCTION HEATER INSTALLATION

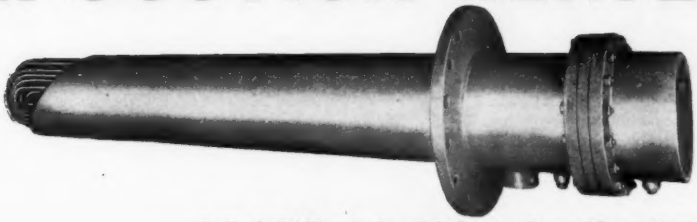
The shell is open at the inside end. The oil moves across the heating tubes as it passes through the shell to the suction connection outside the tank.

??? HAVING TROUBLE PUMPING HEAVY OILS?

??? CONCERNED ABOUT LOSSES RESULTING FROM VOLUME SHRINKAGE AT LOW OIL DELIVERY TEMPERATURES? ...THEN INSTALL

Paracoil

TANK SUCTION HEATERS



In Bulk Oil Terminals and Refineries the world over Paracoil Tank Suction Oil Heaters are licking the problem of economically preheating heavy viscous oils to permit their withdrawal from storage tanks. They are also preheating the lighter grades of fuel oils to their proper delivery temperatures to avoid the costly volume losses incurred when such oils are sold at low temperatures.

WITH PARACOIL TANK SUCTION OIL HEATERS

- **You Heat Only The Oil That Is Being Withdrawn From The Tank.** (Thus radiation losses resulting from heating entire tank contents are eliminated.)
- **Overall Steam Consumption And Heating Costs Are Held To A Minimum.**
- **Heater Tube Bundle Can Be Withdrawn For Inspection And Cleaning.** Breaking of oil suction line not necessary.
- **All Piping Connections And Gaskets Are Outside The Tank.**
- **U-Tube Design Permits Free Expansion And Contraction Of Tube Bundle.** Either high or low pressure steam can be used as the heating medium.

Prompt Shipments!
Our extensive stocks of tubing and pipe enable us to make quick deliveries to meet your immediate requirements.
Write for Descriptive Literature

SPEED UP DELIVERIES AND CUT OIL VOLUME LOSSES WITH PARACOIL TANK SUCTION HEATERS

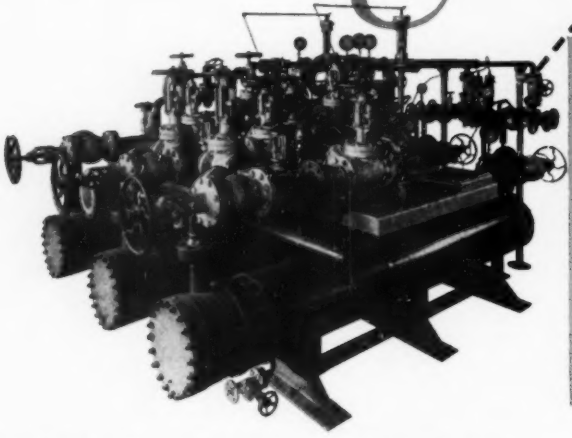
In addition to the Paracoil Tank Suction Heaters, we also design and fabricate Line Type Discharge Heaters of any capacity. Illustrated is a Paracoil Straight Tube Type Fuel Oil Heater for bulk station service—capacity 2,000 gallons per minute, No. 6 oil, 100°F to 160°F, steam at 15 psig. Weight 12 tons.

DAVIS ENGINEERING CORPORATION

1058 East Grand Street
ELIZABETH 4, NEW JERSEY

30 Rockefeller Plaza
NEW YORK 20, N. Y.

World's Largest



PREFABRICATED

PUMPING AND HEATING UNIT

.....*"tailor made"* by

ENCO

This 150 gpm fuel oil pumping and heating unit—the biggest ever built—was engineered and built by Enco for a large steel corporation. One motor and two turbine driven pumps, cross connected with three heaters, furnish fuel oil at desired temperature, pressure, and volume to three boilers producing well over 1,000,000 lbs. of steam per hour. One pump and one heater are always available as spares.

The design and performance of all Enco fuel oil pumping and heating systems from the smallest to the largest ever built provide tangible proof of Enco's skill in the field of pre-combustion preparation of fuel oils. Write for bulletin O B-37 or see your local Enco Representative for details on Enco oil burning, pumping and heating equipment to fit *every* boiler room requirement.

EC-475

THE ENGINEER COMPANY

75 WEST STREET, NEW YORK 6, NEW YORK

Canadian Representative: F. J. Baskin, Ltd.
4220 Iberville St., Montreal 34, P.Q.

10 PLUS FEATURES
That Highlight ENCO'S Superiority

1. COMPLETELY AUTOMATIC OPERATION is assured by automatic temperature and pressure regulation valves.
2. COORDINATED DESIGN SAVES SPACE. All equipment essential to the preparation of fuel oil for combustion is contained in one compact unit.
3. INDIVIDUALLY DESIGNED to meet the specific needs of the particular power plant in accordance with its exact operating requirements.
4. ALL PARTS VISIBLE AND ACCESSIBLE for easy operation, maintenance and repair.
5. PUMPS AND HEATERS are interconnected to provide maximum flexibility of operation.
6. SAFETY VALVES protect individual parts where required.
7. EASIER MAINTENANCE — LESS SERVICE-TIME FOR CLEANING because straight tube, multi-pass heaters with removable heads are used.
8. PUMPS OPERATE AT MODERATE SPEED. Heaters designed to give the correct viscosity and velocity without fouling.
9. SMOOTHER FLOW OF CLEAN FUEL TO FURNACE. Air chamber for each piston pump prevents pulsations — pressure regulator for rotary pumps. Twin type strainers provided to keep atomizer tips from clogging.
10. CLEANER BOILER ROOM . . . all overflows connected to a common outlet; flanged drip pan catches oil drip.

Here's why we recommend Republic Conveyor Belting

R. C. Duncan, President
R. C. Duncan Company (Distributor)
411-419 Washington Ave., North
Minneapolis, Minnesota

A sound production policy helped make Republic Rubber Division a reliable business institution.

FOR LASTING SERVICE

Record Maker Conveyor Belting, designed for heavy service and severe operating conditions. Recommended for many types of abrasive material and for coal, rock and ore. Record maker is one of the many Republic Rubber grades of conveyor belting, meeting hundreds of usual and unusual conditions.

Conveyor belting is a labor saving device and the demand is increasing—especially for the brands made by Republic Rubber Division.

Cotton fabric is the strength member of conveyor belting that carries the load, and the rubber cover protects the cotton reenforcement. The difference in grades depends on the quality of the rubber cover and on the rubber friction between plies. The product you convey determines the grade and specification of belt you need.

Return the coupon or write and we will give you the name of the Republic Rubber distributor in your territory. He will help you select the most practical belting for your needs.

REPUBLIC RUBBER DIVISION
Lee Rubber & Tire Corporation, Youngstown, Ohio
Lee Deluxe Tires & Tubes Conshohocken, Pa.

MECHANICAL RUBBER GOODS BY
REPUBLIC RUBBER DIVISION

HERE'S WHAT REPUBLIC RUBBER DISTRIBUTORS DO FOR YOU

The shopping district for your company may run east and west, north and south across the nation. Thousands of vendors offer you their wares, and which products are best for you? The many interviews, the correspondence, telephone calls, wires, and office expense to make the proper selections are costly operations. The Republic Rubber distributor can save you much of this costly procedure and he can do more than that.

One interview with a Republic Rubber distributor can include the purchase of not one, but many items at one time. One delivery, one invoice, and one check replace many transactions.

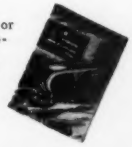
Rapid delivery from stock reduces your inventory investment and hazard. Tell the Republic Rubber distributor your conveyor belting, transmission belting and hose requirements, and he can provide the necessary technical service and carry a stock accordingly.

Your distributor of industrial supplies can be your impartial consultant, balancing the values of competing products as they apply to you. Since he has had personal experience with competing merchandise, and has seen how it performs in not one, but many plants—your industrial distributor is a valuable friend.

Purchasing experts estimate that 80% of all buying can be carried on more efficiently and economically through a distributor.

Republic Rubber sells conveyor belting, transmission belting and hose through distributors, because Republic believes that, by this method, it can serve you far better than any other way. Let us show you. Write or return the coupon below, and we will give you the name of the Republic Rubber Distributor located near you. You'll be glad you did.

In reply to your letter or coupon, Republic Rubber will send you a folder which shows 12 ways for you to save time and money.



WHO REPRESENTS REPUBLIC IN MY AREA?
REPUBLIC RUBBER DIVISION
Lee Rubber & Tire Corporation
Youngstown, Ohio

Name and Title _____
Firm _____
Address _____
City _____ State _____

PUT YOUR FUELS TO WORK WITH PEAK EFFECTIVENESS

CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

As operating expense hits high figures, new savings must be unearthed to combat these excessive costs.

We call your attention to your boiler room. Here is a number ONE place to make cost cuts through gaining peak effectiveness of your fuels.

The way to accomplish this most desirable result is through the installation of a CASH STANDARD Automatic Combustion Control System.

When you do that you realize—LESS FUEL COSTS—LARGER BOILER CAPACITY—SAVINGS IN MAINTENANCE.

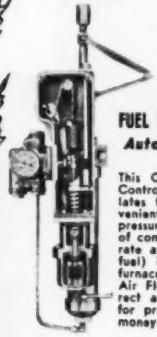
The reason for these three benefits is that these CASH STANDARD units give you CORRECT FUEL FEED—FUEL-AIR RATIO, and OVER-FIRE DRAFT.

Whether you burn coal, oil, or gas these CASH STANDARD UNITS present an immediate opportunity for you to save money and have a highly modern boiler room.

SEND FOR
Bulletin 300
It shows applications—tells how the system works effectively and continuously for a dependable cost saving job.

SYSTEMS FOR ONE OR A BATTERY OF BOILERS

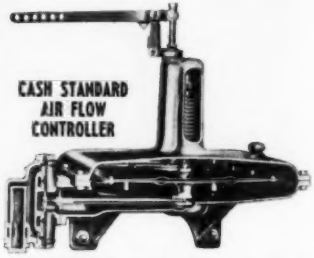
● **CASH STANDARD** units are available in a number of variations. Combinations can be made to give you complete automatic control with all of its benefits. Size of your boiler or type makes no difference.



CASH STANDARD FUEL FEED CONTROLLER . . .

Automatically Regulates Fuel Feed

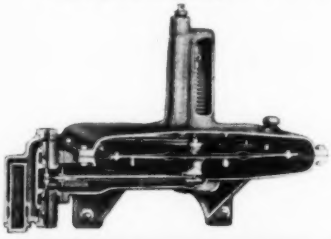
This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion—hence, money saving.



CASH STANDARD AIR FLOW CONTROLLER

Meters the Air Needed for Combustion

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.



CASH STANDARD FURNACE DRAFT CONTROLLER

Maintains a Constant Draft in the Combustion Chamber

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

R/M Style No. 121

R/M High Pressure Packings

The power engineer will find in the R/M line a variety of high-pressure and other packings for practically every power plant need.

R/M High Pressure Packing (Rubber Back)—Style No. 121—consists basically of asbestos cloth over a resilient core of asbestos and rubber. It is widely used for steam hammers and expansion joints, and for the piston rods and valve stems on steam engines, air compressors, and steam pumps.

R/M High Pressure Packing (Center Core)—Style No. 122—consists of a heat-resistant, resilient, rubber core covered by bias-cut asbestos cloth, lubricated and graphited. It is recommended for reciprocating steam or air rods, and valve stems. Also available with wire-inserted cloth.

R/M High Pressure Packing (Solid)—Style No. 124—is similar to Style No. 121, except that it is manufactured solid, without any core, for service in air and gas compressors, in furnace doors and similar applications.

Whatever your packing, gasket, or sheet requirements, consult your R/M catalog and call your authorized R/M packing distributor.

All R/M packings, gaskets, and sheets for maintenance and replacement are sold exclusively through authorized distributors.

RAYBESTOS-MANHATTAN, INC.

Packing Division, Manheim, Pa. | FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles • Mechanical Rubber Products • Abrasive and Diamond Wheels • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Rubber Covered Equipment • Powdered Metal Products • Bowling Balls

NAVCO "Universal" PIPE SUPPORTS

Vertical adjustment up to 2½ inches can be made.

Support may be turned to any angle of 360°.

Will take care of 8 inches of travel.

Features

Universal Pipe Supports hold the pipe down as well as up. They prevent pipe from getting out of alignment, which is usual when Roller Supports are used.

They permit control of expansion movement and insure the desired free action of Slip Expansion Joints so essential in tunnel and duct work.

Expansion movement of pipe will not disturb the insulation.

Made in Cast Iron or Steel and provided with forced lubrication for lines exposed to the weather.

NAVCO

NAVCO PIPING

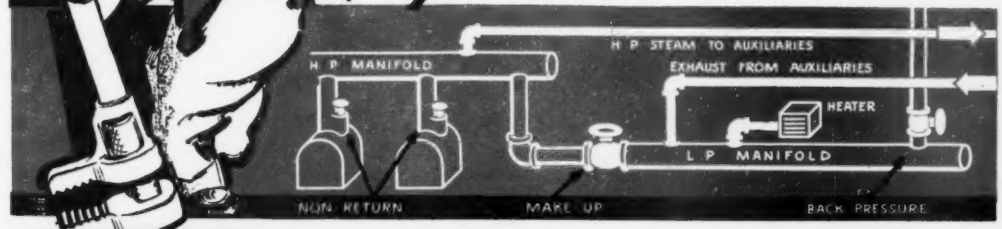
NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO • CINCINNATI

3 WAYS TO KEEP OUT OF TROUBLE

ON

MANIFOLD HEATING SERVICE

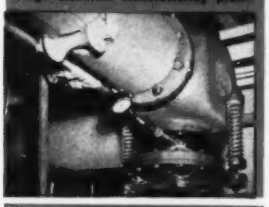


One of two 8" elbow type Foster Automatic Non-Return Stop and Check Valves installed on a pair of CE 56" dia boilers in a well-known chemical plant. Note the man-size handwheel.

Automatic Non-Return Valve, serves as stop and check valve, necessary when more than one boiler serves the same manifold. Outside yoke and handwheel for manual closing — insures positive protection for repairmen when the boiler is down — permits boiler isolation when running separate tests — protects against discharge of steam in case of manifold failure.

Low pressure drop across the seat due to large areas in relation to pipe line sizes. Single seat, guided main valve with internal dash-pot cushion. Sizes 2½" to 12", flanged in angle, globe or elbow types. Standard for 250# saturated steam, 475°F, is semi-steel with bronze trim and alloy steel seat ring; others, suitably trimmed are available for pressures to 1500# and 900°F. Globe type, supplied without screw and yoke for a full sealed line where manual closing is not required, is frequently used as a horizontal check valve in gas or liquid service where exceptional reliability is required.

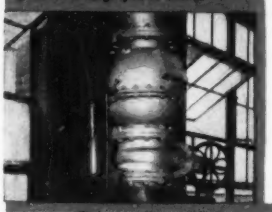
This 8" Foster Type J-2 Pressure Reducing Valve is giving steady, trouble-free performance in heating service for a large chemical manufacturing plant.



Type J-2 Pressure Reducing Valve serves as a make-up valve between the high pressure manifold and the low pressure manifold, so that heating demands are met in spite of any deficiency in supply of exhaust steam from the auxiliaries. Because of its double seated, direct-acting construction, it follows pressure variations in the low pressure manifold rapidly and provides a smooth flow regardless of fluctuations in boiler pressure or in the demand.

Type J-2 is operated by a spring-opposed diaphragm, which makes adjustment and maintenance simple. Standard construction provides for a remote service line which permits use of a relatively large low pressure manifold as a receiver. 1" to 2" sizes available with screwed connections; 2½ through 8", flanged. For initial pressures to 250#, 475°F; reduced pressures from ½# to 50#. Single seated construction available for 1"-2" sizes.

This Foster Type 34-R17 Back Pressure Valve and Vacuum Breaker is giving excellent service in a manufactured gas plant of a large public utility.



Type 34-R17 Back Pressure Valve and Vacuum Breaker protects the low pressure manifold against excess pressures, and assures proper back pressure on auxiliaries. Large area valve in relation to connected line size, provides ample capacity, and promptly relieves small build-up with reduced lift.

Bronze faced dash-pot prevents chattering and definitely prolongs the life of the valve. Provision is made for a water seal so that the system can be operated below amospheric pressure and still give excess pressure protection. Sizes 2½" to 8" with relief of 1# to 15#; 10" to 20" with a range of 1# to 10.# All valves flanged, and suitable for 475°F.

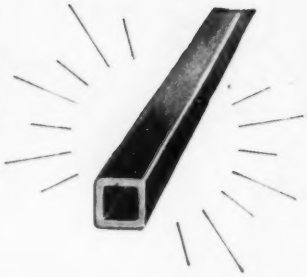
Other Foster Automatic Valves are available for every type of service. Foster Representatives in principal cities will work with you, without obligation, to help you with your engineering problems.

FOSTER ENGINEERING Company

PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS...PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

106 MONROE STREET • NEWARK 1, N. J.

Chase square copper tube bus has great mechanical strength . . .



ALLOWS LONGER SPANS BETWEEN SUPPORTS

SAVINGS in time and cost of installation are often possible if Chase Square Copper Tube Bus Conductors are used. The square construction gives maximum mechanical strength *in all directions.*

High structural strength permits longer spans between supports. Ease of assembly and erection add to the saving in time and money. Since these square copper tubes have four flat sides, adequate and uniform pressure can be exerted between the large contact surfaces, resulting in firm, secure joints. They may be joined by clamping, bolting, or brazing.

That's why we say Chase Square Copper Bus Tubes are the finest you can buy. Write for full specifications and details.

LOOK AT THESE *Advantages*

1. Made of high electrical conductivity copper resulting in high thermal conductivity, low voltage drop and power loss per pound of metal.
2. Square construction provides maximum structural strength; essential in withstanding the very large forces caused by heavy short circuit currents.
3. Four flat sides allow adequate and uniform pressure to be exerted between the large contact surfaces, resulting in firm, secure joints.
4. Square, one-piece construction enables you to assemble conductors, fittings and supports without difficulty.
5. Copper is well known for its excellent resistance to corrosion.

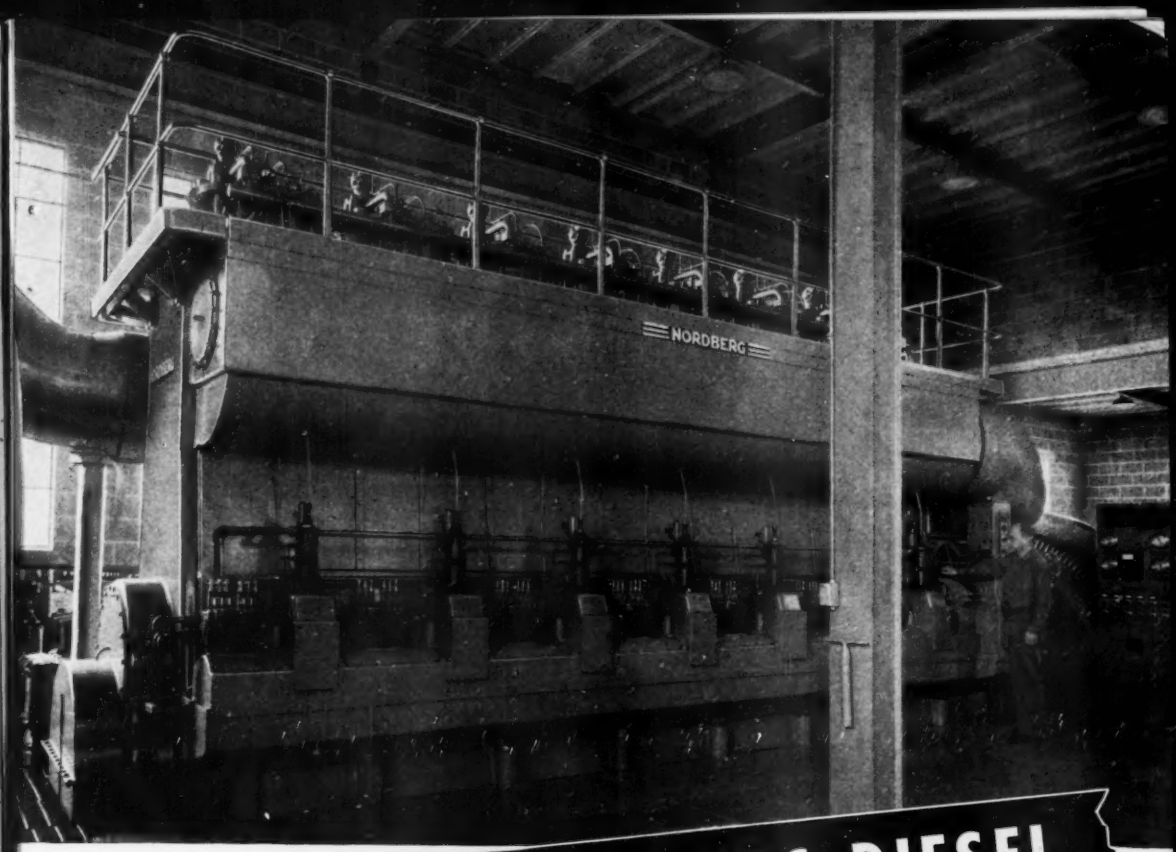
Chase

the Nation's Headquarters for
BRASS & COPPER

WATERBURY 91, CONNECTICUT — SUBSIDIARY OF KENNECOTT COPPER CORPORATION

THIS IS THE CHASE NETWORK . . . *handiest way to buy brass*

ALBANY† ATLANTA BALTIMORE BOSTON CHICAGO CINCINNATI CLEVELAND DETROIT HOUSTON† INDIANAPOLIS KANSAS CITY, MO. LOS ANGELES MILWAUKEE MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER† SAN FRANCISCO SEATTLE ST. LOUIS WATERBURY *(†Indicates Sales Office Only)*



2800 H.P. NORDBERG DIESEL

...for the Michigan Public Service Company

• The Michigan resort country around Montague is another in the ever-increasing list of areas served by Nordberg Diesel Engines. This 2800 B.H.P. unit was recently placed in service in one of the generating stations of the Michigan Public Service Company.

The basic dependability of Nordberg Diesels is no idle claim—*it's a fact,* proved in service on hundreds of successful power applications . . . from the smallest to the largest engine, every Nordberg unit is built to deliver low-cost, trouble-free power for main or standby service.

In the complete line of Nordberg two and four-cycle Diesel engines, including both oil and gas burning types, you will find exactly the right unit to meet your present and future power requirements . . . from 10 to 8500 B.H.P.

NORDBERG MFG. CO.
MILWAUKEE 7, WISCONSIN

P349

A DIVISION OF NORDBERG

NORDBERG
DIESEL ENGINES

FOR THOSE WHO ARE INTERESTED IN COMPACT SPEED REDUCTION . . .

HERE'S THE NEW BOOK THAT GIVES THE ANSWERS

Philadelphia GEARMOTOR

The Philadelphia GearMotoR is a self-contained, *extremely compact* unit that conforms to the recommended standards of the American Gear Manufacturers Association and National Electrical Manufacturers Association.... Available in single, double and triple reductions. . . . Range of speeds: 780 through 7.5 R.P.M. Motor Rating from 1 H.P. through 60 H.P. . . . A-c or D-c.

Send for new 42 page illustrated catalog, which contains full information and data necessary for ordering.

Cross section view of Double Reduction GearMotoR.

Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO
IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

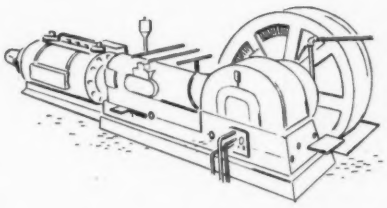
Industrial Gears and Speed Reducers
LimiTorque Valve Controls

WHAT SHOULD YOU EXPECT FROM

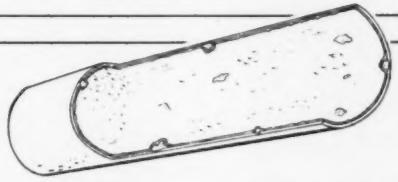
Boiler Water Conditioning?

As a boiler plant operator, you have a right to expect that boiler water conditioning will help you in four ways—to keep boilers clean, to provide pure steam, to minimize corrosion, and to reduce the chances of embrittlement. *These four objectives are written into your Hall contract.*

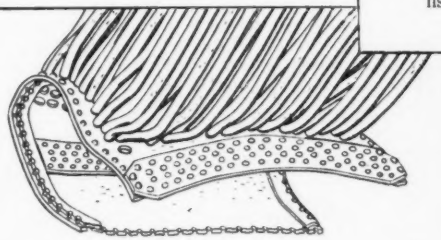
In modern boiler water treatment, chemicals transform scale-forming materials into free-flowing sludge, easily removed in blow-down, thus preventing scale on tube walls. Hall Laboratories discovered how scale really is formed, then how best to prevent it.



Impure steam may be anything from a nuisance to a disaster. Hall service helps you make sure that steam has the purity required for its uses in your plant.



Wherever water is in contact with iron, there is danger of corrosion. Many factors contribute to corrosion, but Hall service will help you to establish conditions which control corrosion.



When boiler metal becomes embrittled, spectacular damage can follow. It isn't common, but it can happen. Hall service helps you avoid conditions which are favorable to embrittlement.

Hall Laboratories serves plants of all sizes, from those which generate less than 1,000 lb./hr. of steam, to those which generate well over 1,000,000 lb./hr. They all find that they can profitably use Hall service.

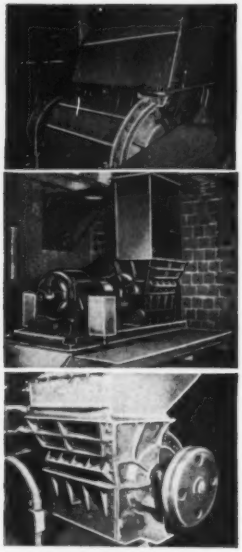
HALL LABORATORIES, INC.

(A Subsidiary of Hagan Corporation)

Hagan Building, Pittsburgh 30, Pa.

CONSULTANTS ON INDUSTRIAL WATER TREATMENT
HALL SYSTEM OF BOILER WATER CONDITIONING
INDUSTRIAL WASTE RECOVERY AND DISPOSAL

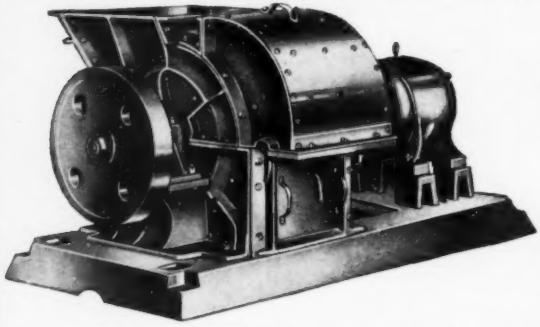
YOUR FIRST STEP toward GREATER COMBUSTION EFFICIENCY...



Custom-built for power plants, American Type "S" Crushers offer 9 different sizes, with capacities from 25 to 500 TP H.

AMERICAN *Rolling Ring* CRUSHERS

Uniform *High* Tonnage Reduction — at *Low* Operating Cost!



American Type "S" Rolling Ring Crusher, with heavy cast steel housing and sectional construction, secured at dust-tight, machined joints with coupling bolts for easy access to crushing chamber.

To hit highest operating efficiency, coal firing depends upon uniform sizing... one reason it pays to include American Crushers in your expansion and change-over plans. The exclusive shredder ring action of Americans—*through splitting instead of crushing coal*—gives a dependable uniform product with controlled fines—assures a loose, uniform firebed quickly responsive to sudden steam demands ... without excessive ashpit drop or unnecessary CO_2.

The minimum headroom requirements and independence from auxiliary crushing permit easy, economical installation of Americans without extensive alterations. Heavy cast steel housing and manganese steel shredder rings assure long, trouble-free service.

Send for your copy of "Crushing Coal for Less than 1¢ per ton"

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE.
ST. LOUIS 10, MO.

Baldwin-Hill

. . . the one-block insulation

made with **BLACK** ROCKWOOL

effective to 1700°F

Send for free copy of our catalog "Industrial Insulation" which describes B-H MONO-BLOCK and other Baldwin-Hill insulations.

Baldwin-Hill Company, 731 Breunig Ave., Trenton, N. J.

Name_____ Position_____

Firm_____

Address_____

For Your

ENGINEERING REFERENCE FILE

POWER offers the following reprints of special editorial sections, covering subjects of vital importance to power men everywhere. Use the coupon below to order those you want.

Cost Postpaid

1. HANDLING CONDENSATE — 16-page section on fundamentals of handling condensate from heating and process. Includes material on equipment for venting, trapping and separating, well illustrated with charts and diagrams 20c

2. HIGH-TEMPERATURE METALS—16 pages reviewing for power engineers the basic properties of metals and alloys, the effects of temperature, the development of the new "super alloys" and the problems of designing equipment for high temperature service 20c

3. HYDRAULIC DRIVES—Descriptive article on construction, operation, and characteristics of hydraulic couplings, torque converters and variable-speed transmissions 15c

4. CIRCUIT PROTECTION — 16 pages covering devices of over current protection in circuits of 600 volts and below. Describes and shows application of fuses, circuit breakers and associated thermal and magnetic devices...20c

5. INDUSTRIAL POWER CLUTCHES —16-page special section describes applications, construction, operation, and characteristics of manually and automatically applied power takeoffs, line-shaft clutches and clutch couplings, including magnetic and hydraulic drives.....20c

Cost Postpaid

6. MODERN DIESEL ENGINES — 50 Years of Progress. 32 pages. Explains how diesels work, auxiliaries, construction, inlet air, gas, supercharging, injection, lubrication, etc.....50c

7. POWER-TRANSMISSION BELTS — 16-page handbook covers the various kinds of belts, tells how to select, install and maintain them. Profusely illustrated with data charts and tables.20c

8. 1948 MODERN PLANT SURVEY—Technical highlights of utility and industrial power-plant construction to meet unprecedented load growth; tabulated engineering features of over 500 new steam installations.....50c

MAIL THIS COUPON

Editor, POWER, 330 West 42nd Street, New York, 18, N. Y.

Please send me ..... copies each of the reprints represented by the number circled below. I enclose check ( ), money order ( ) for $.....

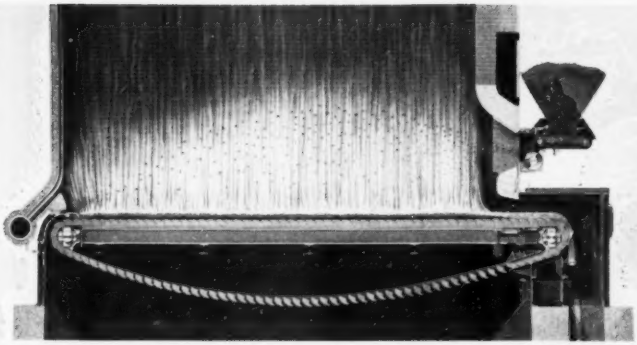
1 2 3 4 5 6 7 8

Name .....

Address .....

City ..... Zone No. .....

State 2/49P



These 4 Spreader Stoker Features Mean Big Savings...

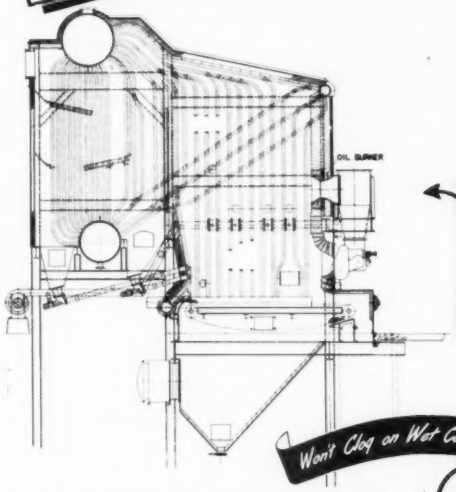
MAKE SURE YOU GET THEM ALL!

INSIST ON:

- Wet, Dry or Frozen Coal Feed—without clogging.
- Even coal Distribution.
- Cinder Return that Works.
- Adjustable Overfire Air.

Æ Perfect Spread Stokers give you all 4 of the features that mean efficient operation and fuel savings. An exclusive feeder that handles zero to 7500 lbs. of coal per hour without clogging and regardless of the condition of the coal. An overthrow impeller designed, after long research into all types, to spread the coal evenly. Separate cinder return lines run from every cinder drain point to the furnace. Each line is separate . . . cinders air-jet propelled. Overfire air nozzles are individually adjustable.

You'll burn less fuel and generate more steam with an Æ Perfect Spread Stoker. And what you burn can be much lower in grade and therefore less costly. Æ adjustable overfire air and cinder return systems insure efficient combustion, reliable operation and offer better control of stack discharge. Write today for a free copy of illustrated catalog and complete information.



1948 installation in Ohio plant of large industrial company. Two Æ Perfect Spread Stokers with 2 feeder traveling grates. Wickes bent tube boilers. Units have normal capacity of 35,000 pounds per hour each, and a maximum output of 38,500 pounds per hour when burning 10,400 per lb. B.T.U. Ohio coal.

FREE—*Your copy of this informative catalog on Æ Perfect Spread Stokers will be sent you on request. Write.*

Won't Clog on Wet Coal!

Other Æ Products: Taylor Stokers—Lo-Hed Electric Hoists & Car Pullers—Hele-Shaw Fluid Power—Marine Deck Auxiliaries.

PERFECT SPREAD STOKER

With Traveling, Dumping or Stationary Grates

A PRODUCT OF

AMERICAN ENGINEERING COMPANY

2400 ARAMINGO AVENUE, PHILADELPHIA 25, PA.

New York Office—75 West Street • Other U. S. offices in principal cities

In Canada: *Affiliated Engineering Corporations Limited, Montreal and Toronto*

JOB WANTED

MANY YEARS OF EXPERIENCE

USERS PRAISE DEPENDABILITY AND LONG LIFE

Self-Operating Easy to Install

POWERS No. 11 REGULATOR

REGULATING TEMPERATURE

OF VATS • TANKS • KETTLES • DRYERS
WATER and OIL HEATERS
JACKET WATER COOLING
DRYING and STORAGE ROOMS
and MANY OTHER USES

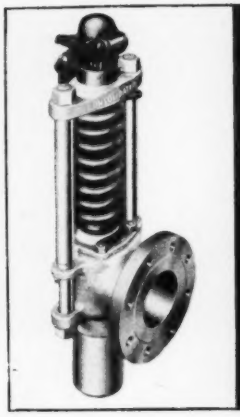
REDUCES COSTS—Maintains a constant temperature. Prevents OVER-heating. Saves steam and labor. Helps to produce a better, more uniform product. Often pays back its cost several times a year and gives 10 to 25 years of service.

THE POWERS REGULATOR CO.
2720 Greenview Ave. • Chicago 14, Illinois
Offices in 50 Cities • Established 1891

▶ *Write for Bulletin 329*

113 2

POWERS No. 11 Self-Operating REGULATOR



New! CONSOLIDATED *Maxiflow* SAFETY VALVE

It solves the problem!

The CONSOLIDATED Maxiflow was designed and engineered to meet operating requirements of high pressure, high temperature steam generating equipment. A new addition to the CONSOLIDATED Safety Valve line, the Maxiflow answers the need for a valve with greater discharge capacity, shorter blowdown and other special characteristics not found in conventional safety valves.

Blowdown, adjustable to a low of 1%, is achieved by advantages no other safety valve possesses.

The CONSOLIDATED Thermodisc seat design —incorporated in the Maxiflow—guarantees a degree of tightness not found in any other safety valve.

Function, design, materials, weight, safety and space—all have been major considerations of creative engineering and unsurpassed workmanship in the development of the CONSOLIDATED Maxiflow Safety Valve.

We will be glad to send you a detailed bulletin concerning the Maxiflow.

MAXWELL MANNING & MOORE INC. MM TRADE MARK

CONSOLIDATED SAFETY VALVES

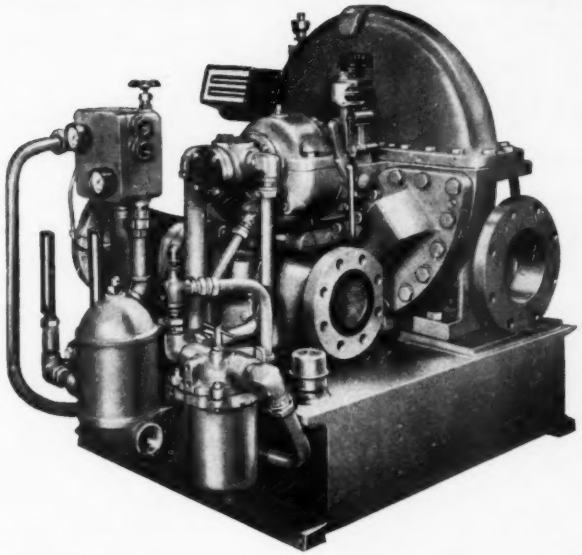
1879 CONSOLIDATED U.S.A.

A Product of
MANNING, MAXWELL & MOORE, INC.
BRIDGEPORT 2, CONNECTICUT

Makers of Consolidated Safety and Relief Valves, 'American' Industrial Instruments, Hancock Valves, Ashcroft Gauges. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load Lifter' Hoists, and other lifting specialties.

MURRAY

TYPE S VARIABLE SPEED TURBINE



Murray Type S Steam Turbines are well suited to a variety of jobs including those drives requiring variable speed. These turbines may be constructed with hydraulic type variable speed governors and complete pressure lubrication system including reservoir, filter, cooler, oil pressure gauges and thermometers.

Turbines so equipped are not only suitable for variable speed operation but for higher operating speeds as well. These features make the Type S variable speed turbine an ideal drive for high speed centrifugal compressors and blowers.

Pictured above is such a machine designed to deliver 400 HP at 7400 RPM. This machine is arranged for speed adjustment by means of hand control or by automatic control. The turbine is also equipped with a vibrating type speed indicator and a remote control tripout device. Note that the construction provides an oil tank of generous oil capacity. The combined base and tank arrangement may be extended for mounting the driven machine if desired.

Write today for full details.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

HOPPES

FEEDWATER HEATERS

Deaerating and Non-Deaerating

• • •

Hot Water Storage Heaters
Low Pressure Closed Type Feedwater Heaters
Instantaneous Water Heaters
Steam and Oil Separators
Cast Iron Exhaust Heads
Blow-off Tanks

• • •

HOPPES

Manufacturing Co., Inc.

Established 1881

SPRINGFIELD, OHIO

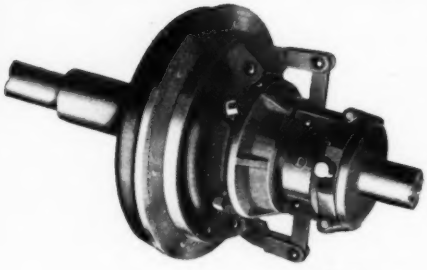
FLEXIBLE COUPLINGS

Everywhere two shafts are joined there exists the possibility of misalignment with its resulting wear-producing stresses. Flexible couplings, by taking care of out-of-line conditions, make for smooth-running and trouble-free machinery — every power engineer should know how they work and how to apply them.

The 16-page special insert in April POWER has the answers—the job flexible couplings handle, descriptions of leading types, pointers on installation, methods of calculating requirements.

WATCH APRIL POWER FOR IT!

JONES-LEMLEY FRICTION CLUTCHES



JONES-LEMLEY friction clutches are built for a broad range of shaft sizes and ratings in both enclosed and open types for sleeve and coupling work. In addition they are available in a line of Jones-Lemley friction clutch pulleys. This clutch modification is also used for gears, V-belt sheaves, sprocket wheels, etc. Sizes, ratings, dimensions, prices and other data are contained in Bulletin No. 60. Your request will bring a copy.

W. A. JONES FOUNDRY & MACHINE CO., 4423 Roosevelt Rd., Chicago, Illinois

Jones

HERRINGBONE—WORM—SPUR—GEAR SPEED REDUCERS • PULLEYS
CUT AND MOLDED TOOTH GEARS • V-BELT SHEAVES • ANTI-FRICTION
PILLOW BLOCKS • FRICTION CLUTCHES • TRANSMISSION APPLIANCES

GET THE DRAFT GAGE THAT

fits your needs

● There's no sense in buying a large, expensive draft gage when a smaller one will serve quite as well, or even better; nor is it necessary to make one gage handle all drafts.

● Hays offers a comprehensive line of draft gages to meet all needs—from the small "B" gage measuring 5 by 7 inches, to the Series FOT—12 by 14 inches with a scale 10¼ inches wide.

● Vital part in all these gages is the famous Hays slack diaphragm measuring unit for pressures to 120 in. water. Above 120 in. water Bourdon Tubes are used.

● Once it's installed, you can forget your Hays Gage. It is designed and constructed to function accurately through many years of dependable service.

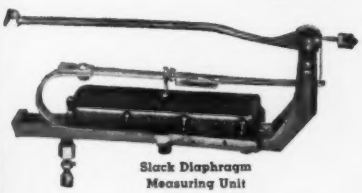
● A "must" for every data file is the interesting booklet: "DRAFT—What, Where, How, Why." Glad to send it on request.

Series FOT Size
14"x12"

Series D Size
12¼" x 9½"

Series V Size
12½"x7"

Series B Size
7"x5"



Slack Diaphragm
Measuring Unit

The HAYS CORPORATION
Since 1901 COMBUSTION & INDUSTRIAL INSTRUMENTS & CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

Now!..with integral stellite seat!

FROM now on, all HANCOCK 600# WELDVALVES have seats of super-hard stellite integral with the bodies. This means seats that never need to be replaced, freedom from leaks, immeasurably long life and utmost economy. And, there is no additional cost.

Add these features:

1. Superfinished 500 Brinell stainless steel discs that eliminate wire drawings, steam cutting, erosion and corrosion.
2. Stem and disc connected by stainless steel ball bearings for longer wear and even distribution of load.
3. No bonnet joint which means elimination of gasket troubles, leakage at bonnet joint, excess usage of bolts and nuts.
4. Real strength in the upper structure—greater than in any conventional design.
5. Corrosion resistance by "resistance" treating.
6. A streamlined valve that allows close alignment of piping with near structures.

Since 1877 "HANCOCK" has meant valve quality and performance in the highest degree. And now that all HANCOCK WELDVALVES are built with integral stellite seats, you may install them, forget them and be sure that utmost economy follows your judgment.

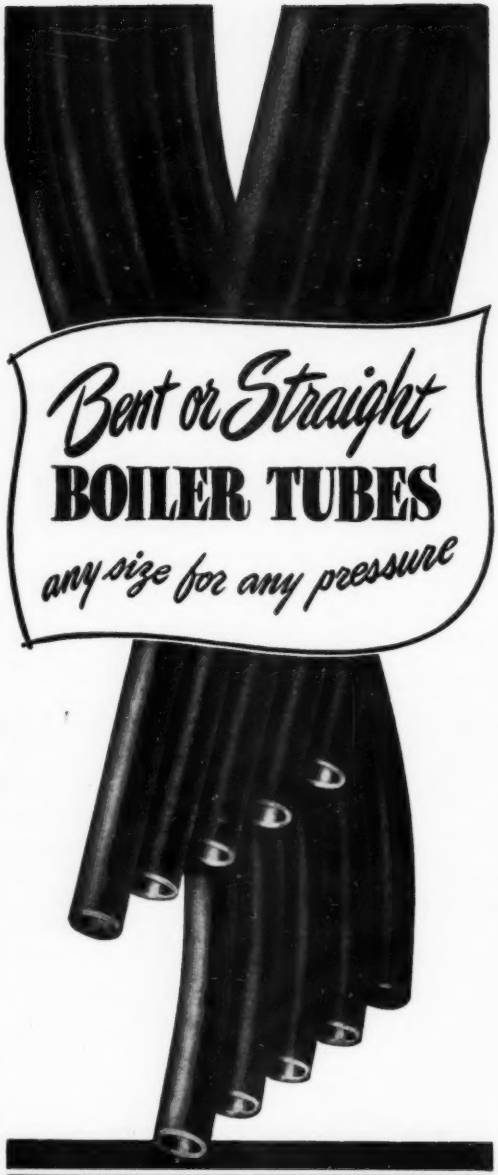
Stocked and sold by leading Distributors everywhere. Write to them or to us for full information.

HANCOCK *Valves*

A Product of

MANNING, MAXWELL & MOORE, INC.
WATERTOWN 72, MASSACHUSETTS

Makers of Hancock Valves, Ashcroft Gauges, Consolidated Safety and Relief Valves and 'American' Industrial Instruments. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load Lifter' Hoists and other lifting specialties.



Bent or Straight BOILER TUBES

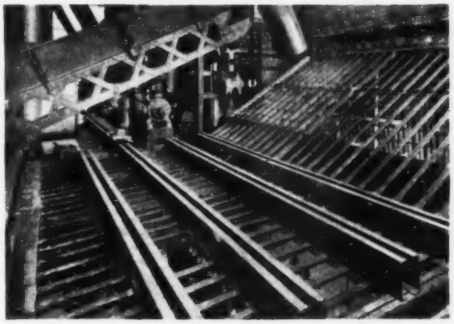
any size for any pressure

BOILER TUBE CO. OF AMERICA

McKEES ROCKS, PA. (Pittsburgh District)

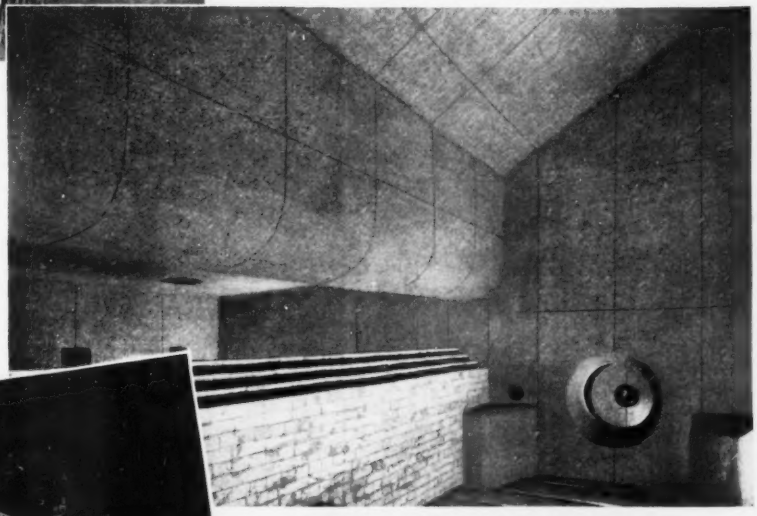
PITTSBURGH · CHICAGO
FRED S. RENAULD & CO., LOS ANGELES

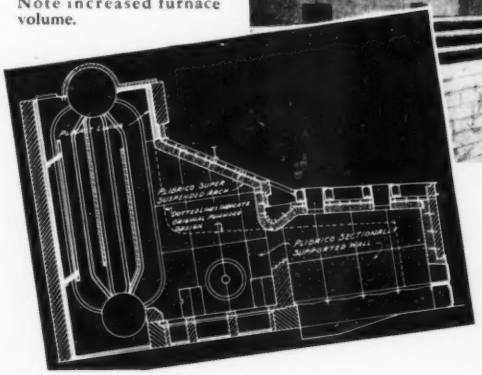
PLIBRICO...makes it look easy!



Photographs show Plibrico installation at Consumers Central Heating Co., Tacoma, Wash., as described here. *Top:* Steel work for new Plibrico arch. *Middle:* Plibrico arch hangers which support the Plibrico material. *Right:* The finished job; Plibrico arch and lining.

Print below shows the modernization of this furnace in detail. Dotted lines indicate original design. Note increased furnace volume.





Solved the Plibrico way, tough problems often look simple. The problem here was to step up the steaming capacity of a 749 hp. Erie City boiler. Actually not a simple problem when you consider that "hog fuel" must be burned—wood refuse from nearby lumber mills having a moisture content averaging about 40%.

The solution was moving the front wall of the Dutch oven forward 3 ft. and raising and sloping the arch. The old tile arch was replaced with a Plibrico suspended arch and the entire furnace relined with monolithic Plibrico Jointless Firebrick.

Results exceeded expectations. Output was stepped up from 50,000 lbs. of steam per hour to 70,000 lbs.—an increase from about 200% of rating to more than 275% of rating. The two 400 hp. Ray oil burners were installed when making the furnace changes as auxiliary fuel burning equipment.

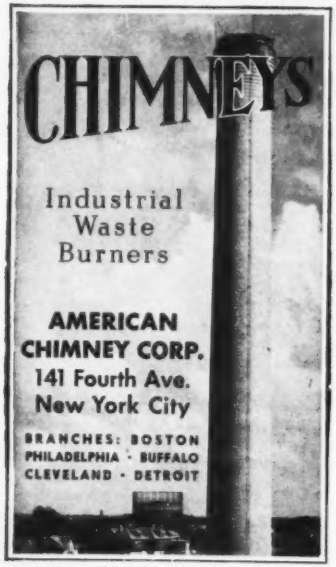
Just one more case among the endless examples of Plibrico design put into effective practice by Plibrico construction methods and boiler setting service. Consult your telephone directory for your local Plibrico Sales & Service organization, or write for Plibrico catalog, specifying water tube or H.R.T. boiler edition.

PLIBRICO JOINTLESS FIREBRICK CO.
1818 Kingsbury St., (Dept. C), Chicago 14, Ill.

PLIBRICO
Suspended Arches

WHERE TO BUY

PROFESSIONAL SERVICES



BIRCH
Pump Valves
•
Standard In
RAILROADS, MINES, WATER WORKS
INDUSTRIALS
● They increase efficiency, capacity, economy—decrease slippage, leakage, fuel consumption—will not sink in seat ports, warp, break, curl, or ride seat bridges. For hot or cold water service . . . thoroughly dependable.
BIRCH MANUFACTURING CO.
1521 Sedgwick St., Chicago, Ill.

ERNST Liquid Level Gages
● Sight Flow Indicators
● Gage Glasses ● Try Cocks
● Gage Glass Washers
WRITE FOR BULLETINS
ERNST WATER COLUMN & GAGE CO.
LIVINGSTON, N. J.

HILL PUMP VALVES
SINCE 1909

● The valve with the renewable feature restores old pumps to original efficiency. Constant contact is maintained over the full bearing surface no matter in what position the valve rotates because of the exclusive HILL design. Efficient, durable, economical, accurate.

Write for Bulletin
HILL PUMP VALVE CO.
2728 Elston Ave., Chicago 47, Ill.

ASSOCIATED ENGINEERS, INC.
Joseph C. Lewis, Pres.
CONSULTING ENGINEERS
Design & Construction Specialists
Reports — Analyses — Surveys
230 E. Berry St. Fort Wayne 2, Ind.

BENJAMIN W. BISSELL
Registered Consulting Engineer
Steam-Diesel, Power Plant, Water Supply, Sewage Disposal, Heating, Air Conditioning, Electrical Distribution Systems, Design and Construction supervision.
514 K. of P. Building, Indianapolis 4, Indiana

BROWN ENGINEERING CO.
CONSULTING ENGINEERS
Power Plants, Substations, Transmission.
Water Supply, Sewage Disposal, Rates
K. P. Building Des Moines 9, Iowa

BURNS & McDONNELL ENGINEERING COMPANY
Consulting Engineers — 50th Year
Power Plants - Steam - Diesel - Hydro
Electric Systems - Rate Reports - Valuations
Water and Sewer Systems and Treatment
Box 7088, Country Club Station,
Kansas City 5, Missouri

FRANCIS J. COONEY
Consulting Engineer
Power Plants Design Economic Surveys
Water Supply Steam Utilization
Trouble Shooting Plans
Commercial Trust Bldg., Philadelphia 2, Penna.

GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS
Industrials and Utilities, Power Plant Design and Construction. Rehabilitation and Maintenance.
Steam — Diesel — Hydro — Sewage
Reports — Examinations — Laboratory
New York Reading, Pa. Philadelphia
Houston Washington

THE KULJIAN CORPORATION
Engineers - Constructors
Power Plants and Industrial Projects
1200 N. Broad St., Philadelphia 21, Pa.
St. Petersburg Washington

T. MASENG & ASSOCIATES, INC.
Engineers
Electrical, Design Structural, Reports Mechanical Rates
7 So. Dearborn Chicago 3, Ill.

PIONEER SERVICE & ENGINEERING CO.
Consulting and Design
Engineers . . Purchasing . .
Specialists in Financing,
Accounting and Other Operations
231 So. La Salle St. Chicago 4

REYNOLDS, SMITH AND HILLS
ENGINEERING CONSULTANTS
Specialists in Design and Construction of Industrial and Central Station Plants
Reports, Analyses and Surveys
227 Park Street Jacksonville, Fla.

SANDERSON & PORTER
Engineers and Constructors
New York Chicago
San Francisco Los Angeles

SARGENT & LUNDY
Engineers
140 South Dearborn St. Chicago, Illinois

J. E. SIRRINE COMPANY
ENGINEERS
Power Plants Consultations
Design Reports
Water Steam Utilization Plans
Greenville South Carolina

STANLEY ENGINEERING COMPANY
CONSULTING ENGINEERS
Power Plants
Steam - Diesel - Hydro
Design - Construction - Test - Valuation
Hershey Building Muscatine, Ia.

JOHN A. STEVENS, INC.
Established 1909
CONSULTING ENGINEERS
Power Plants Paper Mills
Dye Houses Surveys
Lowell, Massachusetts

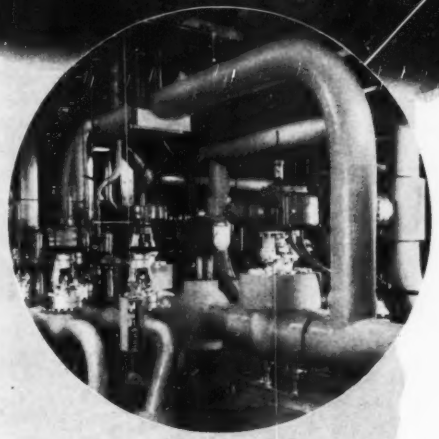
SYSKA & HENNESSY, INC.
Engineers
Consultation Plans Reports
Power Plants Disposal Plants
Water Systems
144 East 39th Street
New York, New York

THE J. G. WHITE ENGINEERING CORPORATION
Design-Construction-Reports-Appraisals
80 Broad Street, New York 4

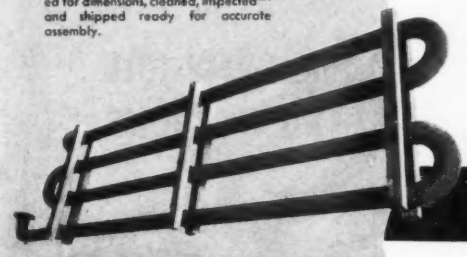
CONSULT THESE SPECIALISTS:
Let them save your time by bringing their broad experience in their specialty to bear on your problems.

Planning A New Power Plant

... or an addition to an existing one?



At P. P. & E. sub-assemblies are shop fabricated under ideal conditions, stress-relieved, pressure-tested, checked for dimensions, cleaned, inspected — and shipped ready for accurate assembly.



For Greatest Efficiency--Turn the *Complete* Piping Job Over to P.P.& E.

Shop fabrication and field erection by Pittsburgh Piping and Equipment Company can relieve you of many responsibilities and assure a piping system that is superior in reliability and economy of operation. Our service begins with the blueprint and ends only when the system is installed.

Materials are selected on the basis of conditions to be met; sub-assemblies are expertly shop fabricated in a modern plant with complete facilities for assembling and testing; field erection is done by skilled and experienced craftsmen.

When you place the complete job in the hands of P.P.& E. — you utilize to the utmost extent the advanced technique that we have developed during almost half a century of producing piping systems for the world's greatest power plants. Consult our nearest representative for further information.

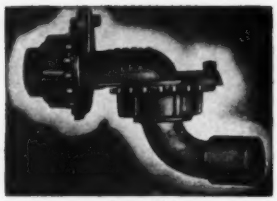
Pittsburgh Piping

AND EQUIPMENT COMPANY

10 Forty-Third Street — Pittsburgh, Penna.

Woolworth Building, New York — *Peoples Gas Building, Chicago*
Chamber of Commerce Bldg., Indianapolis — *Public Square Building, Cleveland*
Book Tower, Detroit — *10 High Street, Boston*
525 Market Street, San Francisco — *Heights State Bank Bldg., Houston*
Whitehead Building, Atlanta

CONVEY STEAM SAFELY and DEPENDABLY with



Style "H"

FLEXO JOINTS

From water to superheated steam —you can count on dependable Flexo Joints to supply fluids to equipment or machinery while in motion, safely and economically. They offer full 360° movement with unrestricted flow in all positions, maintaining even pressure—and temperature. Flexo Joints are made of four simple parts — no springs, no small or loose parts to cause trouble or wear.

Style "A"

Style "B"

Style "F"

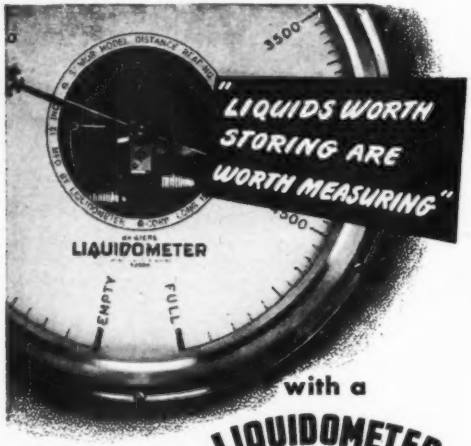
For all standard pipe sizes ¼" to 3".

Write for details and specifications

FLEXO SUPPLY COMPANY, Inc.

4655 Page Blvd. **St. Louis 13, Mo.**

In Canada: S. A. Armstrong, Ltd., 115 Dupont St., Toronto 5, Ont.



with a **LIQUIDOMETER** *Tank Gauge*

- FOR GAUGING LIQUIDS OF ALL KINDS
- 100% AUTOMATIC
- APPROVED BY UNDERWRITERS' LABORATORIES

WRITE FOR COMPLETE DETAILS

THE LIQUIDOMETER CORP.

39-16 SKILLMAN AVE., LONG ISLAND CITY, N.Y.

your industry's BIGGEST TRADE SHOW!

Your industry's biggest trade show isn't a once-a-year event. It comes to you with *every single issue* of this magazine. And, because it is scheduled so frequently, it can bring you a continuing series of up-to-the-minute "displays." In these advertising pages, you will find the latest news about products and services that are specially designed to help you do your job better, quicker, and cheaper. To be well-informed about the latest developments in *your* industry . . . and to stay well-informed . . . *read all the ads too.*

McGRAW-HILL PUBLICATIONS

SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE
(Not available for equipment advertising)
$1.20 a line, minimum 4 lines. To figure advance payment, count 5 average words as a line.
INDIVIDUAL EMPLOYMENT WANTED undisplayed advertising rate is one-half of above rate, payable in advance.
PROPOSALS, $1.20 a line an insertion.

INFORMATION
BOX NUMBERS in care of any of our New York, Chicago or San Francisco offices count 1 line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED RATE:
The advertising rate is $10.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

NEW ADVERTISEMENTS received by March 8th will appear in the April issue, subject to limitation of space available.

SALES ENGINEERING FIRMS FOR PACKAGED STEAM GENERATOR LINE

A leading manufacturer of packaged steam generators, 15 to 250 boiler horsepower, invites inquiries from qualified sales engineering firms who may be interested in a local franchise on contract basis.

Applicant firms must have —

1. Sales coverage of territory
2. Engineering and servicing facilities
3. A reputation for fair dealing

Reply in detail to

RW-7906, POWER
330 W. 42nd St., New York 18, N. Y.

WANTED MANUFACTURER'S REPRESENTATIVE
to contact coal-burning industrial institutions to distribute Today's Coal Bill Reducer (for high pressure boilers) which pays for itself quickly. Sales and combustion engineering experience desirable.
Address — P. O. Box 1367 — Chicago, Ill.

GRADUATE ENGINEER
With five to possibly 10 years design and general engineering experience and with sufficient energy, initiative, and intelligence to qualify for a leading position in near future. Thermodynamic or steam turbine design experience desirable. Mail full resume to

P-7450, POWER
330 West 42 St., New York 18, N. Y.

WANTED
TRANSMISSION SUPERINTENDENT
To operate and supervise 600 miles of new 69 kv transmission line, 30 substations, maintenance crews and equipment. Electrical degree and actual previous transmission and substation experience preferred. Write giving full particulars of education, experience and references.

CORN BELT POWER COOPERATIVE
HUMBOLDT, IOWA

WANTED — CHIEF ENGINEER
To take complete charge of Fox River Valley (Wisconsin) paper mill power plant, supervising the operation and maintenance of high pressure boilers, turbines, and auxiliary equipment. Man with both technical and practical background preferred. Excellent opportunity to use initiative and supervisory ability. Give complete personal and business history in letter of application. All replies held confidential.
P-7996 POWER, 520 N. Michigan Ave., Chicago 11

REPLIES (Box No.):
Address to office nearest you
NEW YORK: 330 W. 42nd St. (18)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

MECHANICAL ENGINEER with five to ten years experience in steam power plant design. Must be capable of coordinating design and supervising preparation of plans and specifications on plants up to 25,000 kw. Opening with consulting engineering firm located in Midwestern city of 25,000 population. Excellent opportunity for a qualified engineer with the proper personality to fit into an existing organization. Apply by letter. Include complete information on education and experience. P-7812, Power.

POSITION AVAILABLE. Electrical or Mechanical Engineer. Qualified in general operations of steam power plant, D.C. substations 13,200 volt underground transmission and 600 volt D.C. distribution systems, trolley and overhead maintenance, etc. Location middle west. Advise qualifications, experience, age and starting salary expected. P-7871, Power.

WANTED: ENGINEERING graduate with some power plant experience to train for position as assistant boiler house superintendent in large industrial plant. P-8005, Power.

STRESS ANALYSTS: Graduate in mechanical engineering or physics with five to ten years experience in theoretical or experimental stress analysis, preferably on pressure vessels and heat exchange equipment. Knowledge of thermal stresses desirable. Excellent opportunity for qualified man in new Research and Development Department Laboratory. Write, giving resume of education and experience. The Babcock & Wilcox Company, Research & Development Dept., Alliance, Ohio.

WANTED, SEVERAL engineering graduates, under 35, by large industrial fire prevention organization maintained by leading insurance group. Permanent position. Periodic inspections and special consulting service for leading industrial plants. Thorough training. P-8023, Power.

WATER CHEMISTS—Engineers: Require water technologists for survey and proposal work in New York office and technical sales representatives and engineering division representatives for major cities in U.S. Dept. U, E. F. Drew & Co., Inc., 15 East 26th Street, New York, New York.

EMPLOYMENT SERVICES

SALARIED POSITIONS $3,500-$35,000. If you are considering a new connection communicate with the undersigned. We offer the original personal employment service (39 years recognized standing and reputation). The procedure, of highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 270 Dun Bldg., Buffalo 2, N. Y.

SALARIED PERSONNEL, $3,000-$25,000. This confidential service established 1927, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, 241 Orange St., New Haven, Conn.

(Continued on page 280)

WANTED

OPERATING SUPERVISOR FOR TONNAGE OXYGEN PLANT

Opportunity in new industry for a man with practical experience in industrial oxygen plants.

Write stating experience, age, education and salary required.

CARTHAGE HYDROCOL, INC.
70 Pine Street
New York 5, New York

WANTED
STEAM PLANT SUPERINTENDENT
To operate new 15,000 kw 600 psi 825° F. steam plant near Humboldt, Iowa. To be responsible for operation and maintenance of all plant equipment and personnel. Write giving full particulars of education, experience, references, and salary expected.

CORN BELT POWER COOPERATIVE
HUMBOLDT, IOWA

COMBUSTION ENGINEER
For a large industry near Montreal to take full charge of a large Boiler House, high pressure boilers and steam turbo generators. Must be practical, thoroughly experienced. None others need apply. Permanent position and good salary. Apply stating age, experience and qualifications.

P-8028, POWER
330 W. 42nd St., New York 18, N. Y.

MECHANICAL ENGINEERS
For Positions of
Project and Senior Engineers
Steam Power Plant and/or Gas Plant Experience Preferred—Ideal Community—Close to Metropolitan Areas. Write to
MECHANICAL ENGINEER
PENNSYLVANIA POWER & LIGHT CO.
ALLENTOWN, PA.

For sale, immediate delivery

ELECTRICAL CONVERTERS

for production of

ALUMINUM, HYDROGEN GAS, ALCALY, etc.

Three Converters,
each consisting of:

One 7200 KVA. Selfstarting Synchronous Motor direct connected to three D.C. Dynamos, each 2200 KW. 5500 Amp. 400 Volt.

(Each converter giving an output of 6600 KW. 16500 Amp. They can also be used for 460 Volt with reduced intensity of current.)

Four Converters,
each consisting of:

One 2200 KVA. Selfstarting Synchronous Motor, direct connected to two D.C. Dynamos, each 5500 Amp. 170 Volt.

(Each Converter with an output of 1870 KW. 11000 Amp.)
(Four Selfstarting Synchronous Motors each 3500 HP. 257 rev. 60 cycles.)

INGENIÖRSFIRMAN MYRÉN & CO.
Gothenburg, Sweden **Cable: "Elektromyrén"**

ELECTRICAL CABLE

BOUGHT AND SOLD

- ★ For every industrial and power application
- ★ LARGE STOCKS ON HAND
- ★ RAPID DELIVERY
- ★ CUT TO LENGTH
- ★ Send us your inquiries

UNIVERSAL Wire & Cable Co.
2660 N. Claybourn Ave. Chicago 14, Ill.

YOUR BOILER
Installed By Us

Will give you higher efficiency, longer, better service. Complete handling and installation facilities for all type boilers and accessories. Our schedule open for starting first quarter 1949 jobs only.

New—used—rebuilt boilers available
Installations made anywhere

Phone - write - wire

INDUSTRIAL EQUIPMENT CO.
Orlando, Florida

WANTED

Air Compressors Wanted

Horizontal Water Cooled—Any size also 2 Stage portable units

L. W. BAUER
North Bergen, N. J.

WANTED

Deaerating boiler feed-water heater, 50,000 to 100,000 pounds capacity.

ROOM 4200
141 W. Jackson Blvd., Chicago, Ill.

WANTED
STEAM GENERATOR

Used 300 to 500 H.P. package type steam Generator, oil fired, 3 phase, 60 cycle 220-440 current, 150 lbs. minimum steam pressure.

N. F. PARENTEAU
3212 N. Marietta Ave., Milwaukee 11, Wisc.

WANTED

Steam Engine Set 500-600 KW Capacity 440 Volt, 60 cycle, 3 phase, Uniflow-Vertical Type Preferred 125-150# Pressure.

LOUISVILLE COOPERAGE CO.
421 W. Avery St., Louisville, Kentucky

WANTED

3—36" Chapman List 35X or equal Wedge Type O.S. & Y. Gate Valves, with iron Body, bolted bonnet, cast iron, bronze mounted disc and rising bronze stem, 125 lb. standard flangers, faced and drilled.

MAHONEY-CLARKE, INC.
217 Pearl Street, New York 7, N. Y.

WANTED

FIRE PUMP CONTROL PANEL—Underwriters presently approved type, primary resistance, 40 h.p., 220 V., with automatic start and stop, and time delay relay. Reconditioned or good used acceptable.

W-7914, POWER
330 West 42 St., New York 18, N. Y.

ENGINEER P.E.

Wide experience design of Public Utility & Industrial Power Plants, both Mechanical & Electrical. Heat Balance, Piping, Coal & Ash Handling, Power & Light distribution, Calculations, Specifications, Requisitions & Supervision.

PW-8054, POWER
330 West 42 St., New York 18, N. Y.

(Continued from page 279)

POSITIONS WANTED

PLANT ENGINEER or Chief Eng. Age 35. Experience 17 years. Power Plant engineering and construction. Steam; refrigeration; electrical; hydraulic; some marine work; instrument; etc. PW-7872, Power.

POWER PLANT Supervisor, technical school graduate, former marine engineer, refrigeration and high pressure power plant experience. PW-7818, Power.

MECHANICAL ENGINEER, age 26, 2½ years experience in steam power plant operation and industrial plant engineering. Now employed in mid-west, desires Eastern location. PW-7976, Power.

GRADUATE ELECTRICAL and mechanical engineer. Twenty years of experience in installation and management of Diesel-electric power plants, substations and industrial maintenance. Would accept permanent position as power plant superintendent or maintenance engineer. Will furnish best references and resume of experience to interested corporations. PW-7837, Power.

MECHANICAL ENGINEER, steam power plant design. Eight years experience with large utility, 7 years teaching. Registered. Desires permanent position preferably in mid-west. PW-8034, Power.

SELLING OPPORTUNITIES WANTED

MAN OF WIDE Experience in power field establishing agency for Rhode Island and Connecticut solicits accounts of high grade power plant equipment and accessories. Has good contacts with leading buyers. RA-7952, Power.

CENTRIFUGAL PUMP Sales Agency wanted, commission basis only, intensive Eastern territory desired. SA-7825, Power.

MANUFACTURERS REPRESENTATIVES seeking additional lines—fine contact covering New York State and Connecticut through architects, consulting engineers, plumbing, heating jobbers, plumbing and heating contractors and industrial plants. RA-8029, Power.

WANTED

ANYTHING wihin reason that is wanted in the field served by Power can be quickly located through bringing it to the attention of thousands of men whose interes is assured because this is the business paper they read.

When Writing Your Ad

Provide an indexing or subject word.

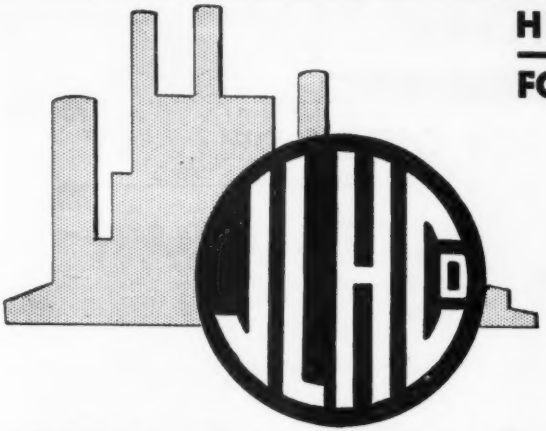
Write it as the first word of your ad.

If it is a Position Wanted or Position Vacant ad, make the first word the kind of position sought or offered.

This will assure proper classification in the column.

The right is reserved to reject, revise or properly classify all Want Advertisements.

Proper Classification increases the possibility of Prompt Returns



HERE IS PROTECTION FOR YOUR PRODUCTION

THE HEMPHILL SEAL
GUARANTEES
YOU'RE GETTING
RELIABLE EQUIPMENT

REBUILT — THEN TESTED BY ELECTRICAL ENGINEERS

TRANSFORMERS

1—1000 KVA G.E., 3 Ph. auto 4150V.—2300V.
1—667 KVA, G.E., 3 phase, Auto, 4150 V.—2300 V.
1—500 KVA Kuhlman 4150 volt primary 2300 volt Sec.
3—300 KVA, Pitts., 2300 V. Pri., 115/230 V. Sec.
3—300 KVA, G.E., type H, 2300 V Pri., 115/230 V Sec.
300 KVA, Pitts., 7800-440 v.
205 KVA, Whse., 2 phase, 2300 to 3 ph., 4150 autp.
200 KVA, 4000 v.—110/220.
100 KVA, Pitts., 1375/2750 v.—110/220.
3—100 KVA, Wagners, 240/120 v.—120 v.
2—100 KVA, Newark, 440 v., 3 phase to 220 v., 2 phase.
2—100 KVA, Whse., 13,800 v. to 250 v.
3— 75 KVA, G.E., 2400 v.—120/240.
6— 50 KVA, Whse., 2400 v.—120/240.
6— 50 KVA, Whse., 13,800 v. to 125 v. or 250 v.
6— 50 KVA, Whse., 6900 v. to 125 v. or 250 v.

A. C. GENERATORS

2500 KVA, Whse., Syn. Cond., 720 RPM, 2400 v.
500 KW, .8 P.F., 5600 RPM, ATB, 600 v.
320 KW, Allis, 450 RPM, 480 v.
240 KW, G.E., ATB, 690 RPM, 600 v.
200 KVA, Allis, 3600 RPM, 240 volt.
200 KVA, Whse., 600 RPM, 240 v.
180 KW, Whse., 514 RPM, 550 v.
165 KW, El. Mach., 514 RPM, 240 V.
100 KW, G.E. ATB, 600 RPM, 240 v.
75 KW, Whse., 900 RPM, 220 v.
62½ KW, Allis, 3600 RPM, 220 v.
7— 50 KVA, Whse., 900 RPM, 220 v.
3— 35 KWA, Columbia, 1200 RPM, 240 v.
1— 31.3 KVA, America, 1200 RPM, 120/208.
15 KW, Star, 1800 RPM, 220/440.
12.5 KVA, Whse., 1200 RPM, 240 v.

TURBINE BLOWERS

1—Spencer Turbine Blower, 1000 cubic feet, 30 oz. pressure with a 15 H.P., 3600 RPM, General Electric Type FT, 200 volt motor.
1—Bellmore, 550 cubic feet, 7 inch vacuum, with a 20 H.P. 3600 RPM, General Electric, Type K, 220 volt 3 phase motor.

MOTORS, 3 Phase, 60 Cycles
SQUIRREL CAGE

750 H.P., General Electric, 750 RPM, 6600 v., 25 cycle.
450 H.P., Ridgeway, 900 RPM, 2200 volts.
125 H.P., G.E., KF, 1750 RPM, 2200 v.
125—H.P., U.S., 1200 RPM, Vert., 220 volts.
150 H.P., G.E., KT, 1200 RPM, Vert., 220 volts.
100 H.P., G.E., 400 RPM, 440 volt.
75 H.P., West., CS, 1750 RPM, 440 volts.
60 H.P., Whse., 900 RPM, Vert., 2200 volts.
60 H.P., Whse., 900 RPM, 440 volts.
2— 40 H.P., G.E., 900 RPM, 220 volts.
35 H.P., Whse., 1200 RPM, CS, 2200 volts.

MOTORS, 3 Phase, 60 Cycles
SLIP RING

2500 H.P., G.E., 257 RPM, 6600 volts.
450 H.P., G.E., 425 RPM, ITC, 440 volts, 25 cycle.
2— 150 H.P., G.E., IM, 440 volt, 450 RPM.
100 H.P., G.E., IM, 440 volt, 25 cycle, 720 RPM.
1—100 H.P. G.E. IM, 440 V. 400 RPM
75 H.P., Whse., CW, 720 RPM, 440 volt.
75 H.P., G.E., MT, 1200 RPM, Vert.
50 H.P., G.E., MT, 600 RPM, 220 volt.
2— 50 H.P., Whse., CW, 900 RPM, 220 volts.
40 H.P., Cont., 1200 RPM, JA85, 220 volt.
40 H.P., G.E., 1200 RPM, MT, 220 volt.
40 H.P., G.E., 900 RPM, 220 Volt, ITC.
40 H.P., G.E., 900 RPM, MT, 900 RPM, 220 volt.
40 H.P., G.E., 900 RPM, 2200 volt.

DIESEL GENERATOR SETS

3—300 KW 125/250 V. De La Vergne—Baldwin 6 cyl., 4 cycle with Westinghouse generators

LARGE STOCK OF
D.C. MOTORS AND GENERATORS

SYNCHRONOUS MOTORS

4—200/100 H.P., Whse., 720/360 RPM, 4150 v.
200 H.P., Whse., 600 RPM, 240 v.
1—200 H.P., G.E., 257 RPM, 440 volt.
1—150 H.P., G.E., 1800 RPM, 220 v., TR
2—150 H.P. Allis-Chalmers 360 RPM, 2200 V.
75 H.P., G.E., 1200 RPM, 440 v.
70 H.P., Elect. Mach., 180 RPM, 2200 v.
40 H.P., Whse., 1800 RPM, 220 v.
35 H.P., G.E., 1200 RPM, 2200 v.
20 H.P., Whse., 1800 RPM, 220 v.

MOTOR GEN. SETS

1—1000 KW Westinghouse, 275 V.—4150—720 RPM Syn.
1—1000 KW, G.E., 600 volts—4150—514 rpm. Syn.
1— 400 KW., G.E., 250 V. 900 RPM, 2300 V. Syn.
1— 500 KW., G.E., 575 V. 900 RPM, 2300 V. Syn.
125 KW, CW, 125 v., 1200 RPM, 2300 v. sq. cage.
100 KW, El. Mach., 125 v., 1200 RPM, 4150 v. syn.
100 KW, G.E., 230 v., 900 RPM, 4150 v. Syn.
2— 75 KW, G.E., 125 v., 1200 RPM, 220/440 v.
6— 75 KW, G.E., 60 v., 1200 RPM, 220/440 v.
50 KW, Ridgeway, 550 v., 1200 RPM, 220 v.
25 KW G.E., AT1, 1800 RPM, 40 HP, 1800 RPM, 230 v.

PLATING M. G. SETS

250 amp. G.E., 5/6 volt, 220 v.
500 Amp., Hansen Van Winkle, 24 volt, 220/440 v.
2500 Amp., Chandeysson, 6/12 v., 400 RPM, Syn., 440 v.
3000 Amp., Chandeysson, 6/12, 400 RPM, syn., 440 v.

ENGINE GEN. SETS

150 KVA, G.E., Ames Uniflow, 220 v., 3 ph., non-cond.
2— 5 KW., Gasoline, Hobart, 1800 RPM, 120 v., 1 ph. cont. engines.
1—200/275 H.P., Gasoline Engine, Van Blerck, 8 cylinder, 1500/900 rpm.

TURBO. GEN. SETS

625 KVA, Westinghouse, 2400 v., 3 phase, non-con.
300 KW, G.E., ATB, 240 v., 3 ph., cond.
60 KW, Whse., 120 v., D.C., cond.
30 KW, Allis, 120 v., D.C., Terry non-cond.

STEAM TURBINES

500 HP., G.E., 3 stage, 165#, 3240 RPM.
800 HP., Terry Tandem type, 720 RPM, red. gear.

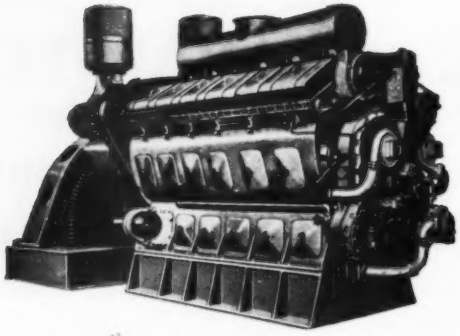
THIS SEAL IS YOUR GUARANTEE

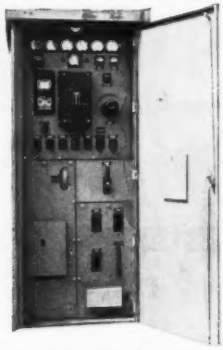
"FOR POWER"
J. L. HEMPHILL & CO.
1604 53rd STREET, NORTH BERGEN, N. J.
PHONE NEW YORK—LONGACRE 5-3227
PHONE NEW JERSEY—UNION 3-2600

DIESEL POWER PLANTS

OFFERED FOR QUICK DELIVERY

FROM AGSCO





1080 BHP GENERAL MOTORS DIESEL ENGINE MODEL 12-567 WITH DIRECT CONNECTED G. E. ALTERNATOR RATED 900 KVA, 3 PHASE, 60 CYCLE, 2400 VOLTS.

• 50 AND 60 CYCLE OFFERINGS •

ALTERNATING CURRENT DIESEL GENERATORS

KVA	Make	Model	HP	RPM
1420	Fairbanks-Morse	38D8⅛	1600	720
1250	General Motors	16-278A	1600	720
1250	Nelseco	6M1-53	1500	300
1000	General Motors	12-278A	1200	720
900	General Motors	12-567	1080	720
800	Alco	6-12½ x 13T	975	720
625	Baldwin	VO-8	750	514
625	Superior	OS	750	327
425	Baldwin	VO-6	510	450
400	Buckeye	80	480	600
375	Enterprise	DSG-6	450	450
312	General Motors	8-268A	450	1200
250	General Motors	8-268A	350	1200
200	Buckeye	80	240	600
125	Superior	GDB-8	150	1200
125	General Motors	3-268A	150	1200
125	Murphy	ME-605	150	1200
121	Fairbanks-Morse	32E14	140	300
75	General Motors	6043E	90	1200
75	Fairbanks-Morse	35E8¾	90	450
62	Int'l Harvester	UD-18	76	1200
50	General Motors	4-71	60	1200
18	Int'l Harvester	UD-6	22	1200

Engineered AGSCO DIESEL POWER

A. G. SCHOONMAKER Company, Inc. ESTABLISHED 1898

Diesel Engines • Power Machinery

52 CHURCH STREET, NEW YORK 7, N. Y. PHONE DIgby 9-4350

Something to remember:

OUR 41 year REPUTATION IS YOUR PROTECTION

WHEN YOU BUY RE NU BILT BELYEA MOTORS FROM BELYEA

RE-NU-BILT EQUIPMENT

Rebuilt in accordance with N.I.S.A. Rebuilding Standards

MOTOR GENERATOR SETS

3 ph. 60 cycle

Qu.	WK	Make	Speed	D.C. Volts	A.C. Volts
1	1800	G.E.	600	125/250	4000
1	1500	G.E.	600	600	2300/4150
1	1500	G.E.	360	275	2200/4400
1	1250	G.E.	600	275	2300
1	1000	Wcrt.	514	250	4150
1	1000	Whse.	514	600	4150
2	1000	Ck. Wh.	720	250	2300/4150
1	800(30)	G.E.	1200	120/240	2300
2	500	G.E.	720	600	2300/4150
1	500	G.E.	720	125	2300/4000
1	400	G.E.	720	250	440/2300
1	400	G.E.	1200	120/240	440
1	350	G.E.	900	125	2300/4150
1	300	G.E.	1200	250	440
1	250	Whse.	1200	250	440
1	150	Cr. Wh.	1200	250	440
1	100	G.E.	1170	125	220
1	100	G.E.	1200	250	2200
1	90	G.E.	1200	60	220/440
1	75	Cr. Wh.	1160	250	220/440
1	75	G.E.	1180	125	2300/4000
6	70	G.E.	1200	70	220/440
2	50	G.E.	1145	125	220

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Type	Volts	Speed
1	5140	Whse.		4150	600
1	4000	G.E.	T8C	2400/4800	900
1	3000	Whse.		4800	720
1	3000	G.E.	ATI	4800	720

ROTARY CONVERTERS

60 Cycle

KW	Make	Speed	D.C. Volts	A.C. Volts
1—2000	G.E.	514	600	13800
1—2000	G.E.	450	600	2300
1—1000	Whse.	900	600	11000
1— 750	Whse.	900	600	13200
1— 500	Whse.	900	250	2300

FREQUENCY CHANGER SETS

1—1000 KW—GE—2 unit—3 Brg. Consisting of—1400 HP—4400 V., 3 ph., 25 cy. Motor and 1000 KW—2300 V. 2 ph. 58.3 cycle gen. with exciter (Gen. can be reconnected for 800 KW 3 ph.)

1—320 KW—GE—2 Unit—3 Brg. consisting of 600 HP—440 V., 3 ph. 60 cy., 8 pf. Syn. Motor and 400 KVA, .8 pf. type AT—3 ph, 120 cy, 720 volt AC generator with direct connected exciter.

D. C. MOTORS

HP	Make	Type	Volts	Speed
7—1500	Whse.		525	600
1—1200	Whse.		600	425
1—800/1000	Whse.		450	600/720
1—700	G.E.	MCF	600	150/525
1—650	G.E.	MPC	250	115/145
1—500/400	G.E.	DYNA	250	1325/2500
1—335	Whse.	MQ	250	300/900
1—200/300	G.E.	MPC	230	360/920
1—275	Whse.	QM-600-6	230	425/850
1—250	G.E.	MPC	230	400/500
1—230	Al. Ch.		230	700
1—150	G.E.	MPC	230	250/450
1—150	Cr. Wh.	CCM	230	300/1050
1—150	G.E.		600	250/750
10—150	Cr. Wh.	83H	230	890
1—150	Cr. Wh.	CMC-65H	230	1150
2—125	G.E.	CD-1832	230	625
1—125	El. Dy.	308	230	750/1500
1—115	Cr. Wh.	JHL	230	1200
3—101	Whse.	SK	230	485/950
2—100	Rel.	1050T	230	400/1200
1—90	G.E.	CDM-1242Z	115	1800
1—50/100	G.E.	CD-175	230	365/730
2—80	El. Dy.	308	230	475/1350
1—75	Whse.	SK-100L	125	650
2—75	El. Dy.	25-8L	230	750/1750
3—60/75	Whse.	SK-200	115	300/700
4—75	Cr. Wh.	53-H	230	860
2—75	G.E.	CDM-1126Y	230	2060
1—60	Whse.	SK-160	550	680
1—60	El. Dy.	25-8	230	525/1050
2—60	Whse.	Hoist.	230	415
1—60	Whse.	SK	230	500/1000
1—60	Whse.	SK-131	230	500/1500
1—60	El. Dy.	258	230	750/1500
2—50	G.E.	RCP-31B	230	1700
4—50	Whse.	Hoist	230	400
1—50	Whse.	SK-153	230	690/1035
1—50	Cr. Wh.	CMC-80H	230	380/750
3—40	Rel.	385 T "VS"	230	400/1500

with 40 KW MG sets, 230 v. DC, 220/440-3-60 Exciters and automatic "VS" control.

SPECIAL—MERCURY ARC RECTIFIERS

1—750 KW—GE Type RHW—6 Anode 575 V., D.C. Form C with 2300 V., 60 cycle transformer and switching equipment.

1—1000 KW—American B.B. Type GRZ-612—12 anode 625 V.D.C. with 1040 KVA O15C—3 phase—13200/6600V-25/60 cycle transformer with full automatic switching equipment along with 2 distribution panels.

1—1000 KW—Al.Ch. type B-612—12 anode 625 V.D.C. with 1140 KVA O15C—3 phase—13500V.—60 cycle transformer with manually operated switching equipment along with voltage regulator and grid control.

A. C. MOTORS

3 ph. 60 cycle

SYNCHRONOUS

HP	Make	Type	Volts	Speed
2—3500	G.E.	T8	2300	257
1—2100	G.E.	ATI	4600	514
2—2000	Whse.		2300	120
1—1000	Whse.		2300	189½
2— 900	Al. Ch.	(New)	2200	150
1— 600	Whse.	Syn.	440	360
1— 500	G.E.	ATI	480	900
2— 500	G.E.	T8	4150	600
1— 450	Whse.	Enc.	2200	128.5
2— 350	G.E.	T8	2200	150
1— 320	G.E.	ATI	2300	600
1— 300	G.E.	ATI	440	720
1— 300	Whse.		2300	720
1— 300	Al. Ch.		440	600
1— 145	G.E.	ATI	550	720
2— 125	G.E.	ATI	440	450
1— 100	Whse.		550	600
2— 100	G.E.	T8-7851	440	450
1— 100	G.E.	T8	440	1800
1— 100	E.M.	Unused	440	600

SLIP RING

1—1000	Whse.	CW	2300	700
2— 700	Whse.	CW	2300	900
1— 500	G.E.	IP	550	505
1— 500	G.E.	IM-Mill	2200	450
3— 450	G.E.	IM	440	506
1— 400	G.E.	IM	2200	252
1— 400	G.E.	IM	440	720
3— 350	Whse.	CW	2200	900
1— 350	G.E.	MT-442Y	2200/4000	253
1— 300	Al. Ch.	3 Brg.	2300	505
1— 300	G.E.	IM	440	720
1— 250	G.E.	MT-424Y	4000	257
1— 250	G.E.	MT-559S	2200	1750
1— 135	G.E.	IM	2300	100
2— 100	G.E.	IM-16	2200	435
1— 75	Whse.	CW-761	2300	1257
1— 75	F.M.	Bv-H16B	2300	1800
1— 60	Cr. Wh.	123-AQ	220	700
3— 55	Whse.	C1-638A	220	870
2— 50	Whse.	C1W-504	440	870
1— 50	Rel.	IXM	2300	880

SQUIRREL CAGE

1— 250	G.E.	KT-559	440	1800
1— 250	G.E.	IK	2200	600
1— 200	G.E.	IK	550	865
1— 200	G.E.	KT-557	440	1800
1— 125	Whse.	MS	440	485
1— 125	(New) G.E.	KF-TEFC	440	1190
1— 125	G.E.	KF-TEFC	440	3585
1— 100	G.E.	IK	440	575
1— 100	G.E.	IK-Vert.	2300	450
2— 100	G.E.	KT-543	220/440	1750
1—60/20	Whse.	C8	220	900/450

Turbo Generators

See our advertisement on page 300

BELYEA BELYEA CO., INC.

Main Office and Shop

43 HOWELL ST., JERSEY CITY 6, N. J.
Phone—Journal Square 2-3334
Also N. Y. City Line—Rector 2-7150

L. J. LAND
Guaranteed Electrical Equipment

1 YEAR GUARANTEE

RELIABLY REBUILT—DEPENDABLE EQUIPMENT

PARTIAL LISTINGS ONLY

SQUIRREL CAGE MOTORS

H.P.	Make	Type	Speed
450	G.E. vert.	KP-6338	1180
380	G.E.	IK	1160
350	G.E. (2)	K-368	875
300	G.E.	KP-6336Z	880
167	West.	25 cy.	1750
138	Al. Ch. (2)	AR-630F	450
100	G.E. (2)	K-844	1175
100	West.	CS	870
100	G.E.	KT-856	865
100	West. (3)	CS	690
75	West.	CS-8068	1760
75	West.	CS-862-C	1150
75	West.	CS	870
60	West.	504-S	1760
60	Rel.	AA-C8084Z	870
50	G.E.	FTR-823	3600
50	Elliott	196	3450
50	G.E.	K-445	1170
50	West.	CS	880
40	G.E.	KT-336	900
40	West.	CS	900

SLIPRING MOTORS

600	Cr. Wh.		514
200	G.E.	MTP	1800
180	G.E.	MT-564Y	590
100	G.E.	IM	1900
100	Al. Ch.		690
75	G.E.	IM	870
75	G.E.	IM	690
60	Al. Ch.		690
60	G.E.	M-6326TEFC	705
50	West.	CW-564	1155
50	Al. Ch.	ARY	575
50	F-M	RV	575
50	G.E.	IM	490
40	G.E.	IM	1200

SYNCHRONOUS MOTORS

H.P.	Make	Type	Speed
800	G.E.	TS	900
400	G.E. (4)	TS-8325	900
260	G.E.	TS	900
200	Ideal (2)		257
180	G.E.	AT1	900
150	G.E.	AT1	720
150	G.E.	TS	1200
125	West.	G	1200
100	Elec. Prods.		1200

A. C. GENERATORS

288 KVA	West.	G	900
200 KW	West.	G	1200
75 KW	G.E.	ATB	360
75 KW	G.E.	ATB	1200

D. C. to A. C. GENERATORS

K.W.	Make	D.C.	A.C.
25	G.E.	230	220
25	Star	115	120
25	Ideal	115	440
25	El. Mchy.	230	440
7½	Hertner	115	440
5	El. Spec.	110	110

600 V. GENERATOR

K.W.	Make	Speed
200	Cr. Wh.	900
30	Burke	1750
30	E.D.	1150

250 V. GENERATOR

K.W.	Make	Speed
500	West.	1100
330	Elliot	1200
300	G.E.	1200
300	Al. Ch.	1200
200	G.E. MPC	1200
150	West.	900
150	West.	1180
150	G.E.	600
50	G.E.	1200
30 (3)	G.E.	1750
30	Cont.	1200
25	G.E.	1200
15	G.E.	1750
10	Star	1750
7½	West.	1200
5	West.	1750

125 V. GENERATOR

K.W.	Make	Speed
750	G.E.	720
140	Cr. Wh.	1200
150	West.	1150
100 (2)	West.	900
100	G.E.	1200
75	El. Mchy.	1200
75	Cr. Wh.	1200
75	Hertzner	1150
50	Sturt.	2800
40	Cent.	1450
30	Ideal (2)	1750
30	L.A.	1450
30	G.E.	1150
20	Delco	1200
15	G.E.	1150
10	Rogers	1450
7½	West.	1200
5	G.E.	1750

LOW VOLTAGE GENERATOR

Amp.	Make	Voltage
8000	H-V-W	6/12
5000	M-B-C/C (2)	6/12
2000	H-V-W	6/12
1000	Chandeysson (2)	6/12
1000	Col.	6/12
125	Hobart (3)	7½
3000	Chandysson	12/24
1000	H-V-W	12/24
300	Star	15
67	Cont.	15
750	Star	15
1000	G.E.	15
800	G.E.	23/28
600	Rel.	24
134	West.	24

LOW VOLTAGE GENERATOR (Cont.)

175	Cr. Wh.	25
550	Col.	27
1600	G.E.	30
800	G.E.	30
400	G.E.	30
200	West.	30
205	G.E.	32
1000	G.E.	33
1000	Chandysson (4)	40
500	Chandysson (3)	40
205	G.E.	42
24	G.E.	44/54
75	G.E.	50/10
800	G.E.	50

550 V. D. C. MOTORS

H.P.	Make	Type	Speed
765	G.E. (6)	MFC	1045/1350

230 V. D. C. Variable Speed Motors

100	Rel.	1050-T	400/1200
100	G.E.	CD-173	400/1200
75	G.E.	D	800/1500
75	Cr. Wh.	CMC-125H	375/750
60	G.E.	C	490/1100
55	Cr. Wh.	CCM-125H	165/500
50	West.	SK	800/1500
50	West.	SK	250/1000
40	Reliance	461T	400/1200
40	G.E. (3)	CD-1441	400/1800
25	West.	SA	800/1800
25	Rel.	185-T	800/1500
25	G.E.	RF-13	400/1800
25	G.E.	RF-14	400/1200
25	G.E.	RF-14	300/1200
20	G.E. (6)	RF-12	400/1200
20	West.	SK	375/1800
15	West. (4)	SK-95	800/1800
15	E.D.		800/1800
15	West.	SK-120	350/1000
15	West.	SK	250/1000
15	West.	SK	800/1800
10	G.E.	RF-10	600/1800
10	G.E.	CD-83	800/1800
10	West.	SK	800/1200
10	West. (3)	SK	800/1800
10	G.E.	RF	400/1800
10	G.E. (3)	RF	400/1200
10	Rel.	131-T	250/1000
7½	West.	SK-70	800/1500
7½	G.E.	RF-10A	450/1800
7½	Al. Ch.		350/1050
5	West. (3)	SK-60	800/1800
5	G.E.	RF-9	450/1800
5	G.E.	RF	450/1800
5	Rel. (2)	46-T	400/1800

230 V. D. C. MOTORS

150	G.E.	RC-19	800
125	GE	CDP125	1300/1750
100	G.E.	RC-14	1750
75	West.	SK-170	635
75	West. (2)	SK-180	475
75	Cr. Wh.	52-HM	480
60	West. (2)	SK-160	680
50	West.	SK-138	1300
50	Diehl	K-10	850

230 V. D. C. MOTORS (Cont.)

50	West.	SK	750
50	West. (2)	SK-140	885
40	West.	SK-103	1750
40	Century	DN-484	1740
40	G.E.	RC	1750
40	G.E.	RC-32	1100
40	G.E.	RC-18	1075
30	G.E. (2)	RC	1200
30	West (2)		975
30	G.E. (2)	RC-33	775
30	West. (2)	SK-143	575
20	G.E. (2)	CD-83	1750
20	G.E. (2)	RC-11	1150
20	Star (2)	SR-316	29.2

115 V. D. C. MOTORS

300	West.	SK	900
100	Cr. Wh.	CMC	900
25	G.E. (2)	CD	1800
25	Cr. Wh.	CCM	750
20	Century	R8	1750
20	G.E. (2)	CD-83	1750
20	West.	SK-110L	750
12½	G.E.	CDM-85	930/1160

TRANSFORMERS

300 KVA—Al. Ch. 3 phase, 4160 V. primary 230 V. secondary.
300 KVA—Pittsburgh, 3 phase, 4160 V. primary, 230 V. secondary.

NEW D. C. STARTERS

150—230 V. Magnetic 5 H.P. to 75 H.P. G.E.—C-H—A-B—W.L., etc.
100—230 V. Manual and Compound 1 H.P. to 5 H.P.—G.E. & C-H.
40—7½ H.P. 230 V. C-H—Magnetic reversing.

A. C. STARTERS

1—473 H.P. West. Magnetic Reduced voltage, 550 V. synch.
4—400 H.P. 440 V. C-H Bal. 9876 Mag. Red. Volt. Synch.
1—250 H.P. C-H 4150 V. synch. full voltage.
1—150/200 H.P. G.E.—440 V. CR-7068 Syn.
3—150 H.P. G.E. 220 V. Cr. 7061 Synch.

NEW A. C. STARTERS

40—C-H. & A-B 2 and 4 speed Magnetic up to 25 H.P.
20—50 H.P. C-H. 440 V. Magnetic.
165—20 H.P. W.L. 440 V. Magnetic.
635—7½ H.P. C-H. 440 V. Magnetic.

AIR COMPRESSORS

425 Cfm. Sullivan 2 stage.
360 Cfm. American 125 lbs.

ELECTRIC & AIR HOISTS

17—2 ton Shepard-Niles 230 V. D.C.
8—300 lbs. P & H. Zip Lift. 3 phase.
2—2 ton Yale & Towne. 3 phase.
1—1 ton Shepard-Niles. 3 phase.
1—½ ton Yale & Towne. 3 phase.
1—2 ton Thor. pneumatic.
1—½ ton Thor. pneumatic.

400 CY. GENERATORS

2—3 K W GE 3/400/115.
1—7½ K W GE 3/400/240.
1—10 KW GE 200/700 Cy.
1—15 KW GE 3/400/240.

EST. 1910 — L. J. LAND INC. — 40th YEAR

156 GRAND STREET — Phone CAnal 6-6976 — **NEW YORK 13, N.Y.**

New England Representative
411 Atlantic Ave., BOSTON, MASS
Phone Liberty 2-4300

South Western Representative
1400 Carr St., HOUSTON, TEXAS
Phone: Charter 4-6558

Pennsylvania Office
10th and Exeter Sts., READING, PA.
Phone Reading 2-6866

POWER EQUIPMENT—READY TO SHIP

SAVE OVER 50% ON NEW INDUSTRIAL BLOWERS AND VENTILATING FANS

AXIAL FLOW VENTILATING FANS

6—16000 CFM Buffalo Forge Co., 3" stat. pres. 1800/1200 rpm. con. 16/4.5 HP., 1710/1150 rpm., 3 ph. 60 cy. G.E. A.C. Motor 220/440 v. totally encl.

2—12000 CFM 3" stat. pres. Sturtevant with dir. con. 10/3 HP., 1775/1180 rpm., 220/440 v. West. CS. TEFC Motor.

1—7500 cfm Clarage with dir. con. 7½ hp., 1750 rpm., 3.3 HP. at 1160 rpm., 220/440 v. 3 ph. 60 cy.

11—6000 cfm Sturtevant Bulletin 512289, 3" stat. pres. 7 blade, dir. con. 5/1.8 HP., 1745/1175 rpm., 220/440 v. 3 ph. 60 cy West. TEFC Motors.

2—5000 cfm Sturtevant 1.8 stat. pres. 4.2/1.35 HP., 1750/1150 rpm., 3 ph. 60 cy. 220/440 v. ball bearing motors.

2—4000 cfm 3" stat. pres. Sturtevant dir. con. 3 speed, TE Westinghouse 220/440 v. Motors.

BRAND NEW TURBO SET

Westinghouse Steam Turbine consisting of 200 kw., 220/440 v., 3 ph. 60 cy. 1200 rpm., 80% P.F. A.C. Generator—40 kw., 120 v. 1200 rpm., D.C. Exciter and Westinghouse Reduction Gear. — Non-condensing.

A.C. MOTORS—3 PH. 60 CY.

No.	H.P.	Make	Type	RPM	Volts
1 new	500	Elec. Mach.	Syn.	120	4000/2200 220/440
3	300	Elec. Mach.	Syn.	720	2300
2	250	G.E.	I	1200	2200
2	200	G.E.	I	880	2200
1	200	West.	CS	900	440
1	175	West.	MS	900	220
1	150	West.	MS	900	220
1	150	West.	Syn.	900	220/440
1	150	West.	Syn.	257	220/440
4	150	L. Allis	Splash Proof	1800	220/440
1	125	Elec. Mach.	Syn.	164	220/440
2	100	Reliance	IT	495	220/440
3	100	Elec. Mach.	Syn	720	220/440
1	100	Allis Chal.		1200	220/440
1	100	West.		1200	220/440
2	100	Louis Allis	OGS	1750	220/440
5	100	Louis Allis	PA	1750	220/440
1	75	Stanley		600	220/440
1	75	Chandler	Syn.	600	220/440
1	75	Elec. Mach.	Syn	900	220/440
1	75	Louis Allis	OGS	1200	220/440
3	75	Louis Allis	FAA	1150	220/440
1	75	G. Elec.	KT-543	1150	220/440
3	75	Armour	AXB	1180	220/440
1	75	Burke	EM-7	1200	220/440
2	75	West.	CS	1800	220/440
1	60	Burke	EM-7	900	220/440
1	60	G.E.	KT-543	900	220/440
3	60	Armour	AXB	900	220/440
1	60	West.	CS-543	1200	220/440
1	60	G.E.	KT-633	1800	550
1	50/32	G.E.	POS	800/640	220/440
1	50	West.	CS-553-A	870	220/440
1	50	Fynn-Weis.	23-V	900	220/440
2	50	G.E.	KT-816	900	220/440
1	50	G.E.	KT-342	1200	220/440
1	50	West.	CS	1200	220/440
1	50	American		880	220/440
1	50	G.E. T.E.F.C.	K-445	1770	220/440
1	50	West.	M-S	1800	220/440

A. C. GENERATORS—3 ph. 60 cy.

No.	KVA	Make	RPM	Volts
1 new	450	Elec. Mach.	120	4000/2200 220/440
3	115	Elec. Mach.	720	220/440
1	100	Elec. Mach.	164	220/440
1	100	West.	600	220/440
	75	Elec. Mach.	900	220/440
	50	G.E.	1200	220/440
new	50	Elec. Mach.	1200	220/440
	37½	Ft. Wayne	1200	220/440
new	25	G.E.	900	220/440
	25	O'Nan	1800	220/440

BARGAIN — FOR SALE
100 KW. DIESEL ENGINE GENERATOR SETS

11—100 KW., 120/240 V. D.C. Delco Generators dir. con. to 150 HP., Model GBD-3, 5¾x7, 3 cyl. Superior Diesel Engines, elec. starting with muffler, power panel and accessories.
2—100 kw 220/440 V AC same as above.
Practically as good as new—Only Used for Spares.

250 VOLT D.C. GENERATORS

No.	KW	Make	Type	RPM
3	250	West.		1200
1	200	West.	SK	500
1	110	West.	SK-190	700
8	100	Reliance	1080-T	880
1	100	West.	SK-188	720
1	100	West.	SK-190	720
1	100	West.	SK-180	900
6	100	Delco		1200
1	100	G.E.	RC-58	850
1	100	West.	SK	850
1	100	G.E.	RCP-36	2100
1	75	Allis Chal.		850
2	75	West.	SK	1400
1	60	West.	SK	2100/1950
1	60	West.	SK-183	1100
1	50	West.	SK-180	400
1	50	G.E.	DLC-303	850
1	50	West.	SK-143	1100

MOTOR GENERATOR SETS—250 V.D.C.
Motors 220/440 volt or 2200 volt 3 phase, 60 cycle

No.	KW	Make	RPM
3	250	Westinghouse	1200
1	200	Westinghouse	720
3	200	Westinghouse	1200
1	100	Westinghouse	700
1	100	General Electric	900
1	100	Westinghouse	600
1	100	General Electric	1800
1	100	Reliance	880
1	100	Delco	1200
2	90	Westinghouse	680
4	75	Westinghouse	720
1	75	Westinghouse	1200
1	60	Westinghouse	1200
1 NEW	50	General Electric	1800
3	40	Westinghouse	900
2	30	Westinghouse	720

VARIABLE SPEED MOTORS—230 V. D.C.

No.	HP	Make	Type	RPM
1	200	West.	SK	400/1000
8	100	Reliance	1050-T	400/1000
1	100	G.E.	RC	450/1200
2	100	West.	SK-183-A	575/1150
1	100	West.	SK-190	600/1000
1	100	West.	SK	600/1200
1	75	West.	SK	1100/1800
3	75	West.	SK	880/1700
1	50	West.	SK-180	320/960
1	50	West.	SK	300/1200
1	50	West.	SK-191	350/1050
1	50	West.	SK-143	350/1750
1	40	Allis Chal.		400/1200
2	30	G.E.	DLE-50	400/1200
1	30	G.E.		800/1200
1	25	G.E.	CD-123	300/1200
1	20	West.	SK-123	400/1000
1	20	G.E.	RF-11	500/1500

SPECIAL BARGAIN AIR COMPRESSOR

6—240 CFM Westinghouse type 3 VS-23 3 cyl. vert., 150 lbs. pres. dir. con. to 50 HP., 220/440 or 2200 v. 3 ph. 60 cy. West Slip Ring Motors, auto. control. Can furnish D.C. Motors or Oil or Gasoline Engines if desired.

SLIP RING MOTORS—3 ph. 60 cy.

No.	H.P.	Make	RPM	Volts
1 New	400	West.	600	2200
1	250	Allis Chal.	870	2200
1 New	200	G.E.	600	220/440
1	200	West.	1800	220/440
1	150	G.E.	1800	220/440
1	150	West.	1150	220/440
1	125	West.	880	2200/220/440
1	100	West.	720	2200/220/440
1	100	Triumph	580	550/220/440
1	75	G.E.	600	550/220/440
1	75	G.E.	720	220/440
1	75	G.E.	900	220/440
1	75	West.	1800	220/440
1	60	West.	900	220/440
1	60	G.E.	720	220/440
2	50	West.	870	220/440/2200

25 CYCLE A. C. MOTORS
3 ph. — 220-440 volts

H.P.	Make	Type	RPM
150	West.	CW	400
100	West.	CW	725
75	West.	MS	400
75	G.E.	M	715
60	West.	CS	1450
50	L. Allis	OGS-115	720
50	Armour	AB-1	720
50	West.		475
40	West.		725
25	West.	MS	715
20	West.	CS	715
20	Allis Chal.		715
15	Allis Chal.		1450
10	West.	CS	725

REDUCED VOLTAGE STARTERS—220 V. 3 ph. 60 cy.
7—100 H.P. Westinghouse Class 11-400
HUNDREDS of A.C. & D.C. BRAND NEW STARTERS all sizes—Gov. Surplus—BARGAIN PRICES

FREQUENCY CHANGERS

1—25 kw., 220/440 v. 3 ph. 180 cy., G.E. dir-con. to 25 HP., 1800 rpm., 220/440 v. 3 ph 60 cy. motors.

SYNCHRONOUS MOTORS

1—New 500 HP., Elec. Machy. Co. 2200/220 or 440 v. 120 rpm.

ENGINE GENERATOR SETS

10—NEW 1 kw. 14.25 v. D.C. and 2 kw., 28.5 v. D.C. Homelite portable gas eng. Gen. sets. Can furnish lamps and batteries. Suitable for farms and camps.
3—5 kva. 120/240 v. 1 ph. 60 cy. Witte Diesel.
2—37½ KVA 220/440 volts 3 ph. 60 cy. Buda DIESELS.
1—50 kva. Elec. Machy 220/440 v. 3 ph. 60 cy. dir. con. Climax GASOLINE Engine.
1—125 kva. 220/440 v. 3 ph. 60 cy. 257 rpm., Erie Ball STEAM.
1—125 kva. G.E. 220/440 v. 3 ph. 60 cy., dir. con. Skinner UNIFLOW Engine.

INDUCTION HEATING CONVERTER

New Van Norman, type indoor, floor, hi-freq. 32 kw. 220 v. 1 ph., 60 cy. 150 A. enclosed type.

HOISTS or WINCHES

200—1½ Ton HAND CRANKED ratio 27:1 thru an enclosed double reduction gear unit with 4 planetary gears mounted on steel plate complete with 48' of ⅜" cable, ratchet type brake, push button release.

CAR PULLER or WINCH

1—Welen, 2 drum Winch or Car Puller rated 8600# per drum with 25 HP. G.E Vertical Motor 230 v. D.C.

GEAR HEAD MOTOR

50 HP., G.E. 220/440 or 550 v., 3 ph. 60 cy., 1755 to 13 rpm., splash proof, ball bearing.

PORTABLE COMPRESSOR

1—315 CFM Ingersoll Rand portable 100 lb. pres. driven by 105 HP Waukesha Oil Engines, 860 rpm
FOR SALE OR RENT

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

GENERATE YOUR OWN POWER WITH "UTILITIES APPROVED" EQUIPMENT

TURBINE-GENERATOR UNITS

3 Phase, 60 Cycle

6250 KVA G.E. condensing, 5 stage, 200# pressure, 600°TT, 2300 volt, 3600 RPM

1563 KVA Allis condensing 200 lbs. pressure, 600 volts, 3600 RPM complete exciter, condenser, switchboard.

1563 KVA G. E. condensing, 300 to 400 lbs. pressure, 2300 volts, 3600 RPM complete exciter, surface condenser.

1250 KVA Allis automatic extraction condensing 300 lbs., 25 lbs. bleeder pressure, 480 volts, 3600 RPM complete exciter, switchboard and condenser.

1250 KVA G. E. condensing, 250 lbs. pressure, 480/600/2300 volts, 3600 RPM complete shaft exciter, switchboard and surface condenser, panel.

1250 KVA G. E. condensing 200 lbs. pressure, 4150 volts, 3600 RPM complete exciter, condenser, panel.

1250 KVA, 480 volts, Allis-Chalmers, 150/175 lbs. pressure complete with surface condenser.

625 KVA G. E. condensing, 150-175 lbs. pressure, 480 volts, 3600 RPM complete exciter, switchboard, surface condenser.

625 KVA G. E. non-condensing, 150 lb. pressure, 15 lbs. back, 2300 volts, 3600 RPM complete exciter, panel.

375 KVA (2) G. E. condensing 400 lbs. pressure, 450 volts, each complete exciter, switchboard, surface condenser.

375 KVA G. E. condensing 125 lbs. pressure, 2300 volts, 3600 RPM complete surface condenser and panel.

250 KVA Allis-Moore non-condensing 200# pressure, 40# gauge back, 440 volts, 3600 RPM.

125 KVA G. E. non-condensing, 175 to 200 lbs. pressure, 10 lbs. gauge back, 2300 volts, 3600 RPM complete.

112 KVA Allis non-condensing 175# pressure, 5# gauge back pressure, 240 volts.

100 KVA Westg. non-condensing, 125 to 150 lbs. pressure, 10 lbs. gauge back, 2400/600 volts, 3600 RPM.

TURBINE-GENERATOR UNITS

Direct Current

(2) 400 KW, 240 volts direct current Crocker-Wheeler—Worthington 440 lbs. pressure condensing steam turbine-generator units.

200 KW (3) New General Electric 120 volts Marine type turbine generator units.

150 KW (2) 120 volts, 250 p.s.i., 650°TT Westinghouse Worthington condensing units.

75 KW Allis Chalmers-Terry, 125 volts, 2400 RPM, 150 lbs. pressure non-condensing turbine generator unit.

60 KW (3) new Westinghouse 120 volt Marine type turbine generator units.

SYNCHRONOUS MOTORS

300 HP 80% P. F. G. E. type ATI, 2300 volts, 720 RPM synchronous motor.

900 HP Allis 3 phase, 60 cycle, 2200 volts, 150 RPM synchronous motor.

MOTOR GENERATOR SETS

1500 KW Allis-Chalmers 550/600 volts, 300 RPM direct current generator direct connected 2150 HP, 3 phase, 60 cycle 4000/6600 volts synchronous motor.

400 KW Gen. Elec. 275 volt DC, direct connected to 710 HP Gen. Elec. 3 phase, 60 cycle, 2300 volt, 720 RPM synchronous motor.

300 KW KW Allis Chalmers, 250 volt DC generator direct connected to a 430 HP Allis Chalmers 3 phase, 60 cycle, 440 volt, 1200 RPM synchronous motor.

62½ KVA G. E. 3 phase, 60 cycle, 2300 volt, 1200 RPM alternator direct connected 75 HP 125 volt DC motor.

50 KW Westg. 125 volt, 1200 RPM direct current generator direct connected 75 HP, 3 phase, 60 cycle, 2300 volt motor.

10 KW, 125 volts DC Gen. Elec. generator with 12 HP, 3 phase, 60 cycle, 220 volts, 1800 RPM motor.

DIESEL GENERATOR UNITS

Alternating Current, 3 Phase, 60 Cycle

375 KVA Fairbanks-Morse, 240 volts, 300 RPM generator direct connected to 450 HP, 300 RPM, 6 cylinder, Model 32-E-14 full Diesel engine complete with switchboard.

(6) 125 KVA Westing., 450 volt, 1200 RPM, direct connected to Gen. Motors Diesel.

DIESEL GENERATOR UNITS

Direct Current

(4) 300 KW, 120/240 volts, 3-wire, 400 RPM Westinghouse direct current generators each direct connected to a 448 BHP Baldwin Diesel engine.

250 KW Crocker-Wheeler, 250 volt, 257 RPM generator direct connected to 360 HP, 6 cylinder late type Fairbanks-Morse full Diesel engine—complete.

STEAM ENGINE-GENERATOR UNITS

Direct Current

400 KW (2) G. E. 250 volts, 360 RPM generator direct connected to Skinner Unaflow vertical non-condensing engine, 150 lbs. pressure, 10 lbs. gauge back.

400 KW Crocker-Wheeler 250 volt, 150 RPM generator direct connected to a 24 x 32 Chase, non-releasing Corliss engine. 150# pressure, 5# gauge back.

275 KW Westinghouse 250 volt, 350 RPM generator direct connected to Ames vertical Unaflow engine.

200 KW, G. E. 125 volt, 200 RPM generator direct connected Skinner Unaflow engine.

STEAM ENGINE-GENERATOR UNITS (Cont'd)

Direct Current

15 KW Crocker-Wheeler, 125 volts, 410 RPM generator direct connected to an American Blower vertical engine.

STEAM ENGINE-GENERATOR UNITS

Alternating Current, 3 Phase, 60 Cycle

1125 KVA G. E. 480 volts, 150 RPM generator direct connected to 28" x 36" Nordberg Unaflow engine.

500 KVA G. E. 240 volt, 360 RPM generator direct connected Skinner vertical Unaflow non-condensing engine.

500 KVA Westg. 480 volts, 164 RPM generator direct connected to 26" x 28" Skinner Unaflow non-condensing engine, 140 to 160 lbs. pressure, 0 to 10 lbs. gauge back.

312 KVA, 220 volts, Westinghouse 200 RPM generator direct connected Harrisburg-Fleming corlis engine, 125 lbs. pressure.

312 KVA G.E. 2300 volts, 360 RPM generator direct connected 12"x12", 4 cylinders Ames vertical Unaflow non-condensing engine.

156 KVA, 240 volts, 240 RPM generator direct connected to 17" x 16" Skinner Counterflow non-condensing engine 100-125# pressure.

125 KVA Westinghouse 240 volt, 257 RPM generator direct connected to Ames Unaflow engine.

DIESEL ENGINES

(10) 900 HP General Motors, Model 12-567 ATL, 12 cylinders, 744 RPM Diesel engines complete with auxiliaries. Practically new.

ALTERNATING CURRENT GENERATORS

750 KVA Westinghouse 3 phase, 60 cycle, 480 volt, 150 RPM synchronous alternator.

580 KVA Allis 3 phase, 60 cycle, 240 volt, 360 RPM alternator.

500 KVA Westg. 3 phase, 60 cycle, 440/550 or 2300 volts, 514 RPM three bearing belted alternator.

400 KVA Allis 3 phase, 60 cycle, 480 volt, 240 RPM alternator.

312 KVA Westinghouse 3 phase, 60 cycle, 600 volt, 600 RPM alternator.

300 KVA G. E. type ATI, 2300/440 volts, 720 RPM generator.

SPECIALS

5425 GPM Worthington 70' head, 1800 RPM centrifugal pump direct connected to 125 HP G. E. 3 phase, 60 cycle, 220 volt slip ring motor.

(2) 1000 GPM, 1270 Ft. Head Morris pumps each direct connected to a 417 HP, 390# pressure G.E. non-condensing turbine.

(1) 700 GPM, 575 Ft. Head Morris Pump direct connected to 160 HP, 200# pressure G.E. non-condensing turbine.

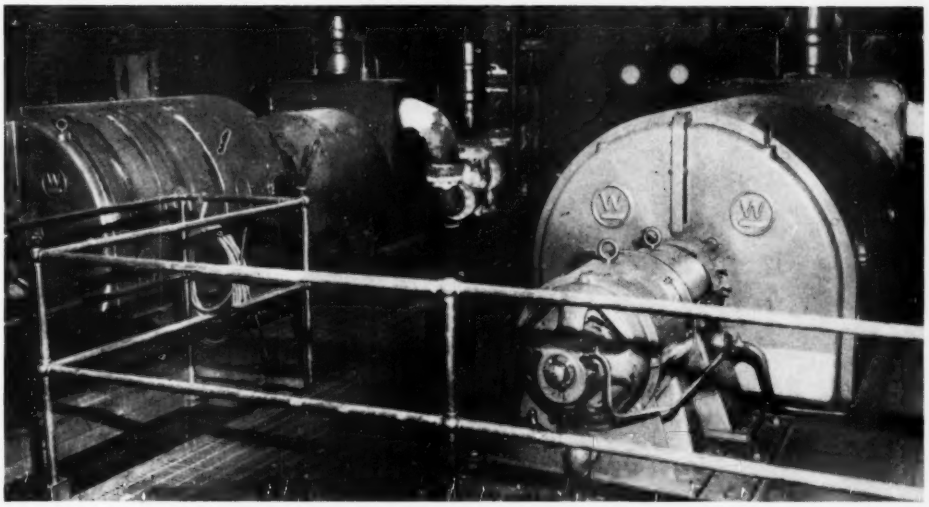
(1) 4400 sq. ft. and (1) 1250 sq. ft. Elliott surface condensers.

10 ton Capacity Brown hand operated traveling crane with 31'10" span including 150" of I-beams.

Utilities Electrical Machinery Corporation
600 NATIONAL CITY BANK BLDG
CLEVELAND 14 OHIO
WIRE OR PHONE
LONG DISTANCE 422

2 NON-CONDENSING

VERY MODERN
2500-KVA TURBO-GENERATORS



Above Cut Made from Photograph taken January 1949.
Illustrates our 2-2500-KVA., Westinghouse Turbine-Generators (Duplicates).
They are Very High Grade (new 1935) modern machines, 250# psi. 15/25# Back. 3/60/2300-v.

SPECIALS Turbo-Generators SPECIALS

2—NEW, NEVER ERECTED 5714-KVA., G.E., 600#-psi., 825° FTT., Condensing, 3/60/2300-v. NEW

1—6250-KVA., G.E., Surf. Cond., 200#-psi. 600° FTT. 3/60/2300-v. Complete Installation

1—3750-KVA., West., Surf. Cond., 200#-psi., 3/60/2300-v. Complete Installation: No. 1 Machine

15—OTHER COMPLETE INSTALLATIONS OF TURBO-GENERATORS, CONDENSING AND NON-CONDENSING, CAPACITIES FROM 450-KVA., to 4000-KVA. ALL HIGH GRADE UNITS: IMMEDIATE DELIVERY.

ALWAYS GET WEAVER'S PRICES: ARE BIG MONEY SAVERS

WIRE
WRITE
OR
PHONE

CHARLES WEAVER

Electrical-Mechanical Engineers

41st Floor, Penobscot Building Detroit 26, Michigan

Telephones:
Woodward 1-1340
" 1-1341
" 1-6038

SEND FOR NEW STOCK LIST — JUST OUT — No. 400: IS FREE

GLOW

SQUIRREL CAGE MOTORS

HP	RPM	Volts	Make
750	900	6600	Westgh.
350	3550	2200	Westgh.-CS
350	514	440	GE-I
250	600	2300	Triumph
200	490	2200	GE
200	600	440	Westg'h-CS
150	600	2200	GE
125	1200	440	Century
100	1800	2300	Burke
100	1200	440	C-W
85	3600	2200	GE
75	900	2300	GE
75	720	2300	Wagner
60	3600	2300	GE-KT
60	1800	440	Al. Ch.
60	1800	2300	GE-FTR
50	3600	440	R. & .I.
50	1800	220	GE-KT
50	900	220	GE
50	720	2300	Wtg.-CS
40	900	2300	Wtg.-CS
40	900	220	Lincoln
40	720	440	GE-KT
30	1800	dual	Delco
30	1200	dual	Master
30	720	220	GE-HJ
30	514	440	Stanley
25	3600	dual	L-A
25	1800	dual	GE
25	1200	220	Wesche
25	900	440	GE
25	900	220	Westgh.-CS
25	720	220	Wagner
25	600	440	GE-I
20	3600	dual	GE
20*	1800	220/440	Master
20*	1800	220/440	Wesche
20	1200	440	Al. Ch.
20	900	440	Wtg.-CCL
20	600	220	GE-KT
15	3600	220	GE-KT
15	1800	220	W-E
15*	1800	220/440	Master
15	1200	220	Ridgeway
15	900	220/440	Westgh.-CS
15	600	220	Burke

ENCLOSED SQUIRREL CAGE

HP	RPM	Volts	Make
125*	1200	440	GE-TE-FC-BB
60	900	440	GE-TE-FC-BB
30	1800	dual	Delco
30	1200	440	Wagner
30	900	440	Reliance, TE-FC-BB
20	3600	dual	Delco-TE-FC-BB
20	1200	440	Wagner
20	900	440	GE-TE-FC-BB
15	1800	dual	Delco
15	1200	220/440	Delco-TEFC-BB
15	900	440	GE, TE-FC-BB
10	1200	440	GE-TE-FC-BB
7½*	1800	dual	Wagner-TEFC-BB
7½*	1800	dual	Master-TEFC-BB
7½	1200	dual	GE-Hi Slip-TEFC-BB
7½	1200	dual	Delco
7½	900	dual	Delco-TEFC-BB
5	3600	dual	Delco-TE-FC-BB
5*	1800	dual	Master-TEI C-BB
5	1800	220	Wagner TE-BB
5*	1200	dual	GE-TEFC-BB
3	3600	dual	Delco, TE-FC-BB
3	1800	dual	Delco-TEFC-BB

*New Motor

ENCLOSED SQUIRREL CAGE—Cont'd.

HP	RPM	Volts	Make
3	1200	dual	Rel-TEFC-BB
3	900	dual	Delco
2	1800	dual	Delco-TEFC-BB
2	1200	220	GE-TE-BB
2	900	220	Wagner-TE-BB
1½	900	dual	Delco-TEFC-BB
1½	1800	dual	L. Al-TE-BB
1½	1200	dual	Delco-TEFC-BB
1	3600	220	Haskins-TEFC
1	1800	dual	Master-TEFC-BB
1*	1800	dual	Delco-TE-BB
1*	1200	dual	Rel-TE-BB
¾	3600	4400	Delco-TE
¾	1800	dual	Wesche-TE-BB
¾	900	dual	Delco-TEFC-BB
½	1800	440	Delco-TE-BB
½	1800	dual	Delco-TE-BB
½	1200	220	Cr. Wh.-TE
¼	900	dual	Delco-TE
1/3	1800	440	Delco-TE

SLIP RING MOTORS

HP	RPM	Volts	Make
500	900	440	GE-3 Brg.
400	1200	2300	Al. Ch.
400	514	4600	Al. Ch.
375	1800	2300	Al. Ch.
350	900	2300	Westgh.
250	300	2300	Al. Ch.
235	1800	220	GE-I
200	900	220	GE-I
75	1800	220	GE
60	1800	dual	Al. Ch.
60	900	2300	Burke
60	900	220	Wesche
50	1800	220	GE-MT
50	900	2300	Ridgeway
50	900	440	Wagner
50	720	440	Al. Ch.
40	1200	220	GE-MT-336
40	900	220	Wtg.-HF
40	720	2300	Wtg.-HF
40	720	220	Al. Ch.-ARY
40	600	2300	Al. CH.-ARY
40	600	220	Al. Ch.-ARY
40	450	220	Triumph-C
35	1200	220	Westgh.
35	900	220	Al. Ch.
35	900	2300	Ridgeway
35	720	220	GE
35	900	2200	GE
30	1800	2300	Wtg.-CW
30	1800	220	GE
30	1200	440	Wagner
30	1200	2300	Lincoln
30	900	220	GE-MT
30	900	2300	F-M
30	720	220	GE-I
30	600	220	F. Morse-BV
25	1200	220/440	Watson-KH
25	600	220	Watson

VERTICAL MOTORS

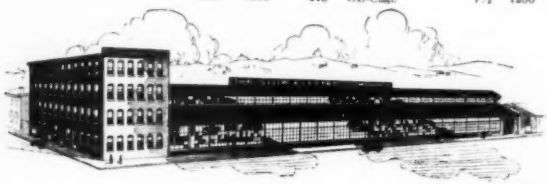
HP	RPM	Volts	Make
200	1200	440	Al. Ch.-SR
150	1200	2200	GE-I-SR
150	1200	440	GE-Cage

VERTICAL MOTORS—Cont'd

HP	RPM	Volts	Make
125	1200	2300	Al. Ch.-SR
125	1200	2300	Al. Ch.-Cage
100	1200	440	GE-Cage
75	1200	dual	Westgh.-Cage
75	1200	2200	GE-Cage
75	360	220	Ideal-Cage
60	1800	230 D.C.	GE
60*	1200	440	Al. Ch.-Cage
50	1200	2200	Wtg.-Cage
50	600	440	Al. Ch.-Cage
40	1800	220	GE-Cage
40	1700	230 D.C.	GE
40	1200	440	Wtg.-SR
40	1200	2200	Westgh.-BB-Cage
35	1200	2300	Al. Ch.-Cage
35	450	440	GE-Cage
30	1200	dual	Wtg.-Cage
25*	1550	230 D.C.	GE
25	1200	2200	GE-Cage
25	850	230 D.C.	Wtg.
20*	1800	440	Al. Ch.
20*	1200	440	Al. Ch.-Cage
15*	1800	440	Al. Ch.-Cage
15	1750	110 D.C.	Wtg.
15	1150	230 D.C.	GE
15	600	440	Al.-Ch.
12½	900	220	L. Al.-Cage
10	3400	230 D.C.	Wtg.
7½	1800	500 D.C.	Peerless
7½	900	440	Burke
7½	700	230 D.C.	GE
6	850	110 D.C.	Rel.
5	1400	230 D.C.	R. & M.
5	600	440	GE-Cage
4	1650	110 D.C.	Watson
3	1700	230 D.C.	Watson
3	1200	dual	Wtg.-Cage

SYNCHRONOUS MOTORS

HP	RPM	Volts	Make
3000	720	4800	GE-ATI
1015	500	2200	Wtg.-25 cycle
710	720	13200/6600	GE
500	514	440	GE
250	720	440	GE-AT
250	225	2200	GE-TS
220	600	2300	GE-ATI
200	720	440	GE-TS
160	600	440	GE-ATI
150	1800	2200	GE
150	720	440	Westgh.
115	164	208	GE
95	1200	220	Burke
75	1200	220	Westgh.
60	360	2200	GE, rotor & stator
50	1200	440	Wagner
50	900	220/440	Westgh.
50	720	440	GE-TS
50	360	440	GE, rotor & stator
30	900	440	Wagner
30	600	550	GE, rotor & stator
30	450	dual	Wtg., rotor & stator
30	360	550	GE
30	327	220	E-M, rotor & stator
25	1800	220	Wagner
25	450	220	E-M, rotor & stator
25	300	220	Ideal
20	1200	440	Wagner
20	900	220	Wtg.
20	600	220	E-M, rotor & stator
15	1800	220	Wagner
15	1200	440	Wagner
10	1800	220	Wagner
10	1200	220	Wagner
7½	1200	410	Wagner



AIR COMPRESSORS

2—Worthington, 11x12, horizontal, 328 CFM at 270 RPM Air Compressors. 100 lbs. pressure with or without motor.

1—Worthington, Feather Valve, 8½x9, horizontal, 170 CFM at 300 RPM Air Compressor, 100 lbs. pressure with or without motor.

D. C. MOTORS

115 Volts

HP	RPM	Description
225	750	GE-MPC
60	1200	Star
35	975	Northern
30	1800	F-M
30	200/600	Sprague
25	1150	Triumph
25	750	GE
20	700	Triumph
20	500/1500	GE-RF11
20	400/1200	GE-RLC fr. 202A
18	600	Sturtevant MPS
15	1200	J. & L.
15	1000	GE-CE
15	975	F-M
15	725	Westgh.-8 fr. 6
12½	1150	GE-RC29
12	1075	J. & L.
12	530	Westgh.-8K-113
10	3450	Imperial
10	1800/3400	Star, 8H-5
10	1200	J. & L.-C1
10	1200/1800	Reliance-7ST
10	650	J. & L., type C1
10	400/1600	Watson-BW15B

D. C. GENERATORS

125 Volts

KW	RPM	Description
500	750	GE-MCF1
300	1500	GE-CC
200	900	GE-MPC
200	800	GE-DMC
100	1000	WE-DLC
100	900	C-W-CCD
75	400	J. & L.-G
65	1100	W-E, type ELC-7
55	1000	GE-Type TD
35	1165	GE-DLC
31.25	1400	Westgh.-8K-single bearing

D. C. GENERATORS—Cont'd.

30	1200	Al. Ch., single bearing
25	1200	Westgh.-8K, single bearing
22	1100	GE-CI
25	600	Al.-Ch.-E-127
15	3600	GE-BF
15	1500	R. & M.
15	1100	Al. Ch.
15	725	Electro Dynamic, single bearing
13	780	Burke-AM3
10*	1750	Westgh.-8K-43
9	1050	GE-MI.
5	1000	W-E (GE)-CD
5	750	GE-RC

D. C. GENERATORS

230 Volts

KW	RPM	Description
400	1200	Westgh.
200	1200	GE-MPC
200	375	J. & L.-type K
175	450	Westgh.
125	1400	Westgh.-8K-130L
80	1050	GE-DLC
75	700	Allis-Chalmers-E4x9
50	1200	Al. Ch.-E-127
35	1800	GE-RC
30	700	Electro Dynamic-158
30	400	Triumph
22½	765	Westgh.-8K
18	300	Burke
15	350	Westgh.-8K

ELECTRIC CO.

AC & DC MOTORS • GENERATORS • PUMPS
SYNCHRONOUS MOTORS • CONTROL EQUIPMENT
MOTOR GENERATOR SETS • ELECTRIC EQUIPMENT
STEAM ENGINE GEN. SETS • SLIP RING MOTORS

927 HARRIET ST.
PHONE MA. 3024
CINCINNATI 3, OHIO

Our 43rd Year

WAGNER

Quality and Service

"CERTIFIED REBUILT"

THE MARK OF DEPENDABLE ELECTRICAL EQUIPMENT

MOTORS . . . GENERATORS . . . M-G SETS

PUMPS . . . FANS . . . BLOWERS . . . SPEED REDUCERS

PARTIAL STOCK LISTING—WRITE, WIRE OR PHONE YOUR REQUIREMENTS

250 KW Allis-Chalmers M-G Set, DC 120 240V. output, 363 H.P. Synch. Motor, 3/60/440V. 1200 RPM, AC & DC panels, late model.

M-G SETS

KW	Mfr.	Input V	Output V
156	Cr. Wheeler*	220/440 AC	250 DC
105	Century b.b.	220/440 AC	70 DC
100	Gen. Elec.*	220/440 AC	250 DC
100	Gen. Elec.*	220/440 AC	125 DC
75	Whse.	220/440 AC	125 DC
75	Star b.b.*	220/440 AC	250 DC
75	Star b.b.	240 DC	230/460 AC
50	Gen. Elec.	220/440 AC	125 DC
50	Reliance	220/440 AC	250 DC
40	Gen. Elec.	220/440 AC	120 cycle
40	Whse.	220/440 AC	250 DC
40	Northw'n Conv.	220 AC	230 DC
35	Gen. Elec.	220/440 AC	48 DC
30	Ideal	220/440 AC	125/250 DC
30	Elec. Prod.*	220/440 AC	50 DC
25	G. E. NEW	220/440 AC	125 DC
20	Whse.	220/440 AC	250 DC
15	Gen. Elec.	220/440 AC	125 DC
10	Allis Ch. (2)	220/440 AC	250 DC

*Synch. motor drive.

D. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
150	Cr. Wheeler b.b.	TEFC	230	800
100	Whse.	SK181	230	450/900
100	Gen. Elec.	C	230	575/1000
75	G.E. New b.b.(2)	CDM	230	1755
75	Cr.W. New b.b.(3)	CMC	230	1150
75	Allis Ch.	E	230	500
75	Whse.	S13L	115	570
75	Gen. Elec.	BRC	115	1150
75	Northw'n	K20	230	1750
60	Gen. Elec.	RC36	230	850
60	Elec. Dyn.	25-S	230	450/900
60	Whse.	SK	230	1700
50	Reliance	262T	230	1100
40	Gen. Elec.	CD93	230	1800
40	Sprague dyna.	LC	230	750/2000
40	Whse.	SK133	230	850
5/50	Gen. Elec.	CD123	230	575/1150
35	Ideal	DV350	230	400/1200
30	Whse.	S-7	115	900
30	Gen. Elec.	RC31B	230	1150
30	Gen. Elec.	RC31	230	1150
25	Sprague dyna.	LC	230	750/2000
25	Chand'son(4)	C13	115	850
25	G.E. b.b. NEW	CDM93	115	1150
25	Gen. Elec.	CD85	230	1750
20	Gen. Elec.	RF12	230	400/1600
20	Whse.	SK93	230	1150
20	G.E. b.b. NEW	CDM83	115	1750
20	Gen. Elec.	RC11	115	1150
20	Reliance	T	230	850
220	Gen. Elec.	DLC	230	500/1500
20	Gen. Elec.	DC85	230	1150
15	G.E. b.b. NEW	CDM67	115	1750
15	Gen. Elec.	RC10	230	1150
15	Whse.(5)	SK90	230	825
15	El. Dyn. b.b. (2)	326	230	1750

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
150	Cr. Wheeler b.b.	TEFC	250	1200
105	Century b.b.	1500n	70	1200
100	Gen. Elec.	RC17	125	1200
100	Gen. Elec.	C	250	750
75	Allis Ch.	E	250	750
75	Whse.	S	125	600
75	Cr. Wheeler b.b.	CCD	250	1450
50	Reliance	T	250	1200
40	Whse.	SK	250	1150
30	Elec. Prod.	BB	50	1150
30	Gen. Elec.	RC	250	1500
30	Ideal 3 wire	HHR	125/250	850
25	G.E. NEW b.b.	CD93	125	1450
24	Whse.	SK	600	850
20	Reliance	T	250	1150

EXPLOSION PROOF MOTORS

from ½ to 20 H P.....std. speeds

Turbo-Generator Bargain!

375 KVA Whse. 3/60/240/480V. Non-Cond.

A. C. MOTORS—25 CYCLE

H.P.	Mfr.	Type	Volts	Speed
150	Whse.	HF	440	500
150	Gen. Elec.	IK-16	440	750
50	Allis Ch.	ANY	440	750
50	G.E. int.	MTC5337	440	750
50	G.E.	I-K	440	750

A. C. GENERATORS—60 CYCLE

KVA	Mfr.	Type	Volts	Speed
625	Gen. Elec.	ATB	2300	450
500	Allis Ch.	3 brg.	240/480	360
375	Whse.	G	240/480	900
250	Whse.	G	2300	600
200	Gen. Elec.*	ATB	240/480	600
156	G.E. 1 brg.	ATB7558	240/480	1200
150	Gen. Elec.	ATB	240/480	900
125	Whse.	G	240/480	720
125	Gen. Elec.	ATB	240/480	900
125	Gen. Elec.	ATB	240/480	900
100	Whse.	G	2300	900
100	Gen. Elec.	ATB	240/480	1200
63	El. Machy.	180 cy.	240/480	1800
56	Gen. Elec.	ATB	240/480	900
50	Cont. b.b.	8107	120/208	1200
25	Whse. b.b.	1 ph.	120/240	900
12½	Whse. b.b. NEW		240	1200

A. C. MOTORS—SLIP RING

3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	600	Gen. Elec.	I-M	360
1—	450	Whse. 2200 V.	CW	600
2—	300	Allis Ch. 2200 V.	ANY	720
1—	300	G.E. 2200 V.	I-M	1800
1—	150	Whse.	HF13AH	720
1—	150	G.E. 2200/4000 V.	I-M	1200
1—	150	G.E. int. duty	ITC-15	720
1—	150	Allis Ch.	ANY	600
1—	125	Gen. Elec.	IM-1A	720
1—	100	Allis Ch.	ANY	1800
1—	100	Al. Ch. b.b. NEW	ARY	600
1—	100	Allis Ch.	ANY	720
1—	100	Whse. int. 2200 V.	C1856C	600
1—	100	Gen. Elec.	MT556	900
2—	75	Gen. Elec.	IM-14	720
1—	75	G.E. int.duty	MTC5342	900
1—	75	Ideal int.	AVE	1200
1—	75	Gen. Elec.	MT558	600
2—	75	Gen. Elec.	IN-14	600
1—	75	Gen. Elec.	MT337	1800
2—	50	Allis Ch.	ANY	900
1—	50	Howell	SR437	1200
1—	50	Fair. Morse	BV	720
1—	50	Gen. Elec. int.	ITC	600
1—	50	Whse. int.	CI	600
1—	50	Gen. Elec.	I-M	720
1—	40	Gen. Elec.	MT336	900
1—	40	Gen. Elec.	MT327	1800
1—	37	G.E. int.	ITC	600
1—	30	Gen. Elec.	GMT336	1200
1—	30	Gen. Elec.	MT346	600
2—	25	Gen. Elec.	MT332	900
1—	25	Triumph	SR	1200
1—	25	Gen. Elec.	I-M	600
1—	20	G.E. int.	MTC5312	900
1—	20	G.E. b.b.	MT503	1800
2—	20	G.E. int.	MTC3302	1200
1—	15	Gen. Elec.	MT302	1200
1—	15	P & H b.b. int.	W7	1200

A. C. MOTORS—SYNCHRONOUS

H.P.	Mfr.	Type	Volts	Speed
667	Gen. Elec. .8 PF	ATI	2200	450
450	Whse.		220/440	900
300	Whse.	G	2200/440	600
250	Ideal	2BC-M4	2200	450
220	G.E. 3 brg. .8 PF	ATI	220/440	600
150	Gen. Elec. .8 PF	ATI	2200	450
150	Gen. Elec.	ATI	220/440	300
150	Whse.	G	220/440	720
125	Whse.	G	2300	900
125	G.E. spiprf. .8 PF	TS935	220/440	1200
125	Gen. Elec.	ATI	240/440	900
100	American b.b.	YGH	220/440	900
108	Gen. Elec.	ATI	220/440	1200
	Ge n. Elec.	ATI	220/440	900

A. C. MOTORS—SQUIRREL CAGE

3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	300	Gen. Elec.	IK-16	1200
1—	200	Reliance b.b. NEW	C6085	1200
2—	200	Reliance b.b. NEW	C6085	1800
1—	200	Allis Ch.	AN	1200
1—	200	L. Allis 2200/3800 V.	OGK-144	900
1—	150	Allis Ch. 2200 V.	b.b.	720
1—	150	Reliance b.b. NEW	14C6085	720
1—	150	Whse. 2200 V.	CS771-1C	1800
1—	150	Reliance b.b. NEW	B6085	1200
1—	150	Gen. Elec.	IK-15	900
1—	150	Reliance b.b. NEW	B6085	900
1—	125	Reliance b.b. NEW	C5085	1200
2—	125	Allis Ch. 2200 V.	AN	1200
1—	125	Gen. Elec.	IK-16	450
1—	125	Cont. 2200 V. b.b.	SC	1800
2—	125	Rel. TEFC NEW	B6085	1800
1—	100	Gen. Elec.	I-K	900
4—	100	Allis Ch. 2200 V.	AR226	1200
1—	100	Reliance b.b. NEW	C5085	900
1—	100	Elec. Machy.	b.b.	1200
1—	100	Rel. TEFC NEW	C5085	1200
1—	100	G.E. b.b. NEW	K504S	1800
1—	100	Cont. TEFC	NP682	1200
1—	75	Reliance b.b. NEW	C5084	900
1—	75	Gen. Elec.	KT552	900
1—	75	Reliance TEFC NEW	C5084	1200
1—	75	Reliance b.b. NEW	C505	1800
1—	75	Gen. Elec.	KT329	3600
1—	75	Whse. hiforq	CS-607	1200
2—	"	Reliance b.b. NEW	C505	1200
1—	60	Gen. Elec.	KT346	900
2—	60	Reliance b.b. NEW	B504	1800
2—	60	Rel. TEFC NEW	C505	1200
2—	60	Reliance b.b. NEW	C504	1200
2—	60	Whse. H. T.	CS504	1800
1—	60	Wagner b.b.	RP444	3600
1—	60	Allis Ch. 4000/2200 V.	ARK23	1800
1—	50	Whse. b.b. NEW	CS4058	1800
1—	50	G.E. 2 phase	1-Q	900
2—	50	G.E. NEW b.b. HT	KG405	1800
2—	50	Reliance b.b. NEW	445	1200
2—	50	Gen. Elec.	KT336	1200
1—	50	Gen. Elec.	KT342	900
1—	50	Whse. hislip	WL607	900
1—	40	Al. Ch. 3 speed	ARX 900/600/450	
5—	40	Gen. Elec.	KT336	900
2—	40	Reliance b.b. NEW	C404	1800
2—	40	Rel. TEFC NEW	C445	1200
3—	40	G.E.	KT532	1200
2—	35	Gen. Elec.	I-K	720
2—	30	Howell b.b. speed	SC	1800
2—	30	G.E. NEW b.b.	K365	1800
2—	30	G.E. NEW hiforq	KG365	1800
2—	30	G.E. TEFC b.b.	K404	1800
1—	30	Gen. Elec.	I-K	900
1—	30	Gen. Elec.	KT336	720
1—	30	Wagner	22T8P	900
1—	30	Whse.	CS646	900
2—	30	Reliance b.b. NEW	C405	1200
2—	30	Reliance TEFC NEW	C444	1200
1—	30	Cr. Wheeler b.b.	SC30Y	1800
2—	25	Gen. Elec.	KT326	1200
2—	25	Rel. TEFC NEW	C444	900
3—	25	Reliance b.b. NEW	C364	1800
2—	25	Reliance TEFC NEW	B365	1800
2—	25	Reliance b.b. NEW	C404	1200
2—	25	Reliance TEFC NEW	C405	1200
2—	25	Whse. NEW spl. b.b.	CS365	1800
3—	25	Whse.	CS646	900
2—	25	Gen. Elec.	I-K	600
1—	20	Reliance b.b. NEW	C404	900
1—	20	G.E. TEFC b.b.	K404	1200
4—	20	Reliance b.b. NEW	C364	1800
2—	20	L.A. NEW exp. prf.	EX364	1800
2—	20	Whse. NEW b.b. spl.	CS364	1800
2—	20	Gen. Elec.	KT312	1200
1—	20	Whse.	CS	1200
2—	20	G.E. NEW b.b.	K365	1200
2—	20	Diehl TEFC NEW	INF364	1800
2—	20	Century b.b. 4 speed	8C594	1800
4—	15	G.E. NEW b.b.	K324	3600
2—	15	Whse. NEW TEFC	CS326	1800
1—	15	Diehl TEFC NEW	INF365	1200
1—	15	Gen. Elec.	KT512	900

ARTHUR WAGNER COMPANY

1435-38 W. RANDOLPH STREET CHICAGO 7, ILL. MONroe 7409

DIESELS–1948

During the year 1948 . . . . . F. L. CUSAC and Associates, Inc. installed DIESEL POWERED GENERATOR SETS totalling . . . $1,475,000.00

Represented in this figure is more than 11,500 KILOWATTS of connected power. Single and multiple unit installations have been made for both public utilities and private owners.

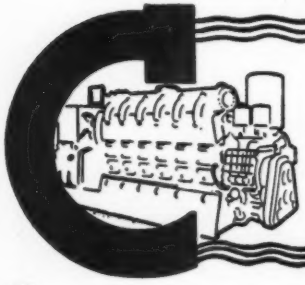
Each and every installation has carried a 100% performance bond—a standard feature of Cusac service.

We invite your inquiries on

DIESEL GENERATOR SETS

Each and Every unit—Cusac Engineered*—has met with complete customer acceptance.

*CUSAC ***Engineered*** means a complete, competent, dependable engineering service from purchase of the equipment to final operating approval.



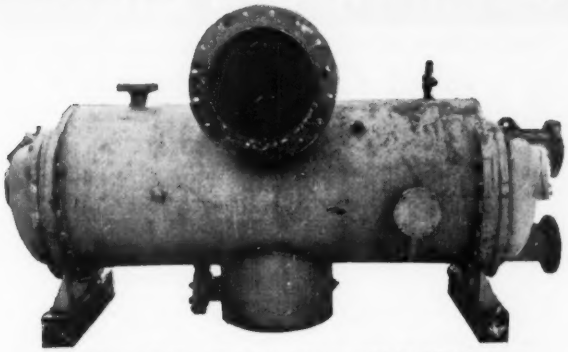
F. L. CUSAC *and Associates Inc.*

DIESELS

Webster 9-4180

BOARD of TRADE BLDG. — — CHICAGO

LIQUIDATION SALE—Modern Equipment



400 sq. ft. new Surface Condenser 2 pass, mfd. by Allis-Chalmers.

CONDENSERS

(Most are new)

No.	Sq. Ft.	Make	Passes	Tubes
1	8533	Bethlehem	1	Brass ¾"
4	3300	Str. Wells	2	Alu-Brass ¾"
1	2200	Alco	2	Cu Ni ⅝"
4	1050	Conseco	2	Cu Ni ⅝"
1	750	Bethlehem	2	Brass ⅝"
30	400	All. Chalm	2	Brass ⅝"
4	300	Wheeler	2	Cu Ni ⅝"
8	155	Conseco	2	Brass ¾"
44	349	Luboil Coolers		Cu Ni ⅝"

BOILERS

10—Cleaver-Brooks, 2000# steam pr. hr. 35# press.

3—Cyclotherm 3000 pounds steam per hour, 125# press.

6—Express Boilers, modified D type, Foster Wheeler 30,000# steam/hr., 435#.

2—Type "D", water tube, Foster Wheeler, 15000# steam/hr., 275# press.

DISTILLING PLANTS

2—8000 gallons per day Griscom Russell, Soloshell double effect, low pressure.

10—2000 gals. per day Kleinschmidt vapor compression distiller mfd. by Badger.

1—750 gals. per day, same as above.

BLOWERS—AIR PUMPS

8—Blowers, Roots Connersville, size 16x18, serial No. 14862, capacity 5000 CFM against 6 lb. sq. in. ga. pressure or 3450 CFM when creating 20" Hg vacuum, with 200 HP motors 3/60/2200 (mfd. 1942). Also available: 1 R.C. Blower, size 20x23 with 350 HP motor

1—Air Pump, Ingersoll Rand, type FS546, 5500 CFM, discharge press. 24.22 abs., intake press. 20.61 abs., with 125 HP motor 3/60/2300 (mfd. 1942).

1—Air Pump, Ingersoll Rand, type FS548, 6690 CFM, discharge press. 20.86 abs., intake press. 17.10 abs., with 150 HP motor 3/60/2300 (mfd. 1942).

1—Blower, Buffalo, size 60, type R, with 150 HP motor 3/60/2200.

SPECIAL

2—BRAND NEW 200 KW turbogenerators, 3 phase, 60 cycle, 450 volts, turbines 540# p.s.i.g., 1# abs. exh. press., mfd. by Westinghouse.

AXIAL FLOW FANS

12,000 CFM, 3" S.P. 3/60/450 Sturtevant
10,000 CFM, 3" S.P. 3/60/450 Clarage
5,000 CFM, 3" S.P. 3/60/450 La Del
35,000 CFM, 1" S.P. 230 V. D.C. Wing
Rugged construction, acid resisting vanes, totally enclosed motors, all NEW

MOTORS

3 Ph. 60 Cy.

6—3800 HP 1700 V 257 RPM G.E.
5— 700 HP 2300 V 128 RPM

D.C.

1500 HP 525 V DC 600 RPM W'hse.
667 HP 374 V DC 1300 RPM Elliott
444 HP 250 V DC 900 RPM Elliott
222 HP 230 V DC 3050 RPM W'hse.
15 HP 120 V DC 500 RPM Diehl

GENERATORS

1200 KW 525 V DC 750 RPM All. Chalm.
1075 KW 375 V DC 750 RPM Elliott
700 KW 240 V DC 500/720 Elliott

TURBO-GENERATORS—A.C.

1—1000 KW All. Chalmers 3/60/600, 3600 RPM, cond., 140# steam press.

2—250 KW G.E. type AT1 3/60/450, 1200 RPM, cond.

2—200 KW Westinghouse, 3/60/450, 1200 RPM cond. (NEW).

6—200 KW G.E. type ATB 3/60/450, 1200 RPM cond. and non-cond.

2—132 KW G.E. type ATB 3/60/450, 1200 RPM, cond.

TURBO-GENERATORS—D.C.

KW	Volts	Winding	Speed Type
2—375	180/240	Shunt.	1200 non-cond.
5—300	120	Compd.	1200 cond.
1—300	120/240	Compd.	1200 cond.
2—250	240	Compd.	1200 cond.
12—150	120	Shunt.	1200 cond.
12— 60	120	Stab. Sh.	1800 cond.
3— 25	120	Stab. Sh.	1200 cond.

WIRE ROPE SLINGS

Dia. from ⅜" to 2½"
Length from 10 ft. to 150 ft.

REDUCTION GEARS

4—1800 HP 2.41:1 10—20 HP 41:1
10— 900 HP 2.48:1 10—11 HP 39:1
10— 25 HP 20:1 10—10 HP 1750:63
7—Waterbury Hydraulic type K, size 35.5 and 2a

FORCED DRAFT BLOWERS

1—Forced draft blower, Sturtevant, Rexvane, size 24, capacity 20,000 CFM, 17" S.P., max. 24,000 CFM, driven by Sturtevant turbine, 191 HP, 320# to 400# steam press., exh. press. 10#.

ICE PLANTS (New)

2—22 ton capacity, Freon 12, mfd. by Frick.

HOISTS

10—100,000# pull at 10 FPM to 3000# pull at 400 FPM. 2 Gypsies 12000# pull at 125 FPM, driven by 50 HP 230v. D.C. motors 525—1800 RPM.

15—15,000# pull at 78 FPM, 3360# pull at 348 FPM and 2 auxiliary drums. Driven by Chrysler 28.35 H.P. gasoline engines. (NEW).

DIESEL ENGINES

HP	MAKE	MODEL	RPM	CYCLE	YEAR
1800	General Motors	16-2585	900	4	1943
1600	Fairbanks Morse	38D O/P	720	2	1944
1600	Hamilton	RB99-D.A.	700	2	1944
1600	General Motors	16-278A	720	2	1944
1200	General Motors	12-278A	750	2	1944
900	General Motors	12-567ATL	750	2	1942/44
500	Superior	6-cyl.	514	4	
300	Fairbanks Morse	38-O/P	1200	2	1936
150	Superior	GDB-8	1200	4	1942/44

DIESEL GENERATOR SETS

AC	200 KW	3/60/450	1200 RPM	General Motors	8-268A	1943 rebuilt
	100 KW	3/60/450	1200 RPM	General Motors	3-268A	1943 rebuilt
DC	1200 KW	525V	750 RPM	General Motors	16-278A	1943
	650 KW	240V	750 RPM	General Motors	12-567	1943
	125 KW	120/240	600 RPM	Superior	VDMB	
	100 KW	120/240	1200 RPM	Superior	GDB-8	1942/44
	100 KW	120/240	1200 RPM	General Motors	3-268A	1943/44
	10 KW	120	1200 RPM	Hercules	DOOD	1943

WRITE OR CALL FOR DETAILS

HUGO NEU CORPORATION

31 Nassau Street New York 5, N. Y.

Tel. REctor 2-1334

ARRANGE FOR INSPECTION

"BREW, WOLTMAN OFFERS"

TURBINE UNITS

1— 9375 KVA Cond. 50 cy. 13800 V. 600-lb. 825 deg. FTT. With surface condenser & boiler. NEW.
1— 3800 KVA G. E. Non-C. 60 cy. 13200 V. 600-lb.
1— 3750 KVA West. Cond. 60 cy. 2300 V. 200-lb.
1— 3125 KVA G. E. Cond. 60 cy. 2300 V. 200-lb.
1— 2500 KVA G. E. Cond. 60 cy. 2300 V. 200-lb.
1— 1563 KVA G. E. Extraction 60 cy. 2300 V. 400-lb. extraction 160-lb. Cond.
1— 1563 KVA Al. Ch. Cond. 60 cy. 600 V. 200-lb.
1— 1250 KVA DeLaval Non-C. 60 cy. 2300 V. 250-lb.
1— 1250 KVA Allis Cond. 60 cy. 2300 V. 200-lb.
1— 1250 KVA West. Non-C. 60 cy. 2300 V. 275-lb.
1— 937 KVA G. E. Cond. extraction 60 cy. 480 V. 375-lb.
2— 625 KVA G. E. Cond. extraction 60 cy. 480 V. 375-lb.
1— 625 KVA G. E. Non-C. 60 cy. 240 V. 175-lb.
1— 600 KVA Allis Cond. 60 cy. 480 V. 150-lb.

WATER TUBE BOILERS

2— 600 HP B. & W. 350-lb. Stokers.
1— 518 HP Titusville 200-lb. Stoker.
2— 500 HP B. & W. 200-lb. Stokers.
1— 500 HP Union City 400-lb. Pulverizer.
1— 418 HP Combs. Engr. 400-lb. Stoker.
1— 180 HP Frost 200-lb. return tubular.

STEAM ENGINE UNITS—60 Cy.

1— 1250 KVA Nordberg Uniflow, 480 V.
1— 450 KVA Ames Uniflow, 2300 V.
1— 400 KVA Skinner Uniflow, 480 V.
1— 312 KVA Skinner Uniflow
1— 150 KVA Ames Uniflow, 220 V.
1— 125 KVA Ames Uniflow, 2300 V.

D.C. STEAM ENGINE UNITS

2— 750 KW Skinner Uniflow 250 V.
1— 300 KW Skinner Uniflow 275 V.
1— 275 KW Ames Vertical Uniflow 250 V.
1— 200 KW Skinner Uniflow 250 V.
1— 200 KW Skinner Uniflow 125 V.
1— 100 KW Skinner Uniflow 230 V. 3-wire.
1— 75 KW Ames Vertical 125 V.

DIESEL ENGINE UNITS

2— 1600 HP Fair. Morse 60 cy. 2300 V. NEW gen.
1— 720 HP Amer. Loco. 240 V. DC.
1— 625 HP Worth. 240 V. 60 cy. gen.
1— 600 HP Fair. Morse 2400 V. 60 Cy.
1— 480 HP DeLaVergne 2400 V. 60 cy.
1— 375 HP Worth. 240 V. 60 cy. gen.
2— 240 HP Fair. Morse 2400 V. 60 cy.
1— 150 HP Gen. Motors 3-378A-60-3-480.
2— 135 HP Murphy 240 V. 60 cy.

SYNCHRONOUS MOTORS — 60 Cy.

2— 3000 HP G. E. 1700 V. 257 RPM
1— 1400 HP G. E. 4150 V. 514 RPM
1— 880 HP G. E. 6600 V. 514 RPM
1— 600 HP G. E. 440 V. 360 RPM
2— 500 HP E. M. 2200 V. 514 RPM
3— 400 HP E. M. 440 V. 600 RPM
1— 350 HP G. E. 4800 V. 225 RPM
1— 300 HP G. E. 2300 V. 600 RPM
1— 300 HP West. 2300 V. 900 RPM
1— 250 HP West. 600 V. 180 RPM
1— 250 HP G. E. 550 V. 400 RPM
1— 200 HP G. E. 220 V. 600 RPM
1— 100 HP G. E. 2300 V. 240 RPM (Super)

INDUCTION MOTORS — 60 Cy.

1— 8000 HP Cr. Wh. S/R 2200 V. 895 RPM
1— 7200 HP S/R 11000 V. 750 RPM 25 cy.
1— 1200 HP Al. Ch. S/R 2200 V. 440 RPM
1— 1000 HP G. E. S/R 2200 V. 514 RPM
1— 300 HP West. S/R 2200 V. 1770 RPM
1— 250 HP G. E. S/R 2200 V. 1800 RPM
3— 200 HP E. M. S/C 480 V. 1800 RPM
1— 200 HP Cr. Wh. S/C 2300 V. 720 RPM. New.
1— 200 HP G. E. S/R 2200 V. 435 RPM
1— 150 HP Cr. Wh. S/C 440 V. 1800 RPM
1— 150 HP Al. Ch. S/C 440 V. 1200 RPM
1— 150 HP Cr. Wh. S/C 440 V. 900 RPM. New.

MOTOR GENERATOR SETS

1— 1500 KW Al. Ch. 600 V. DC 60 cy.
1— 1200 KW G. E. 125/250 V. DC 60 cy.
2— 1000 KW G. E. 600 V. DC 60 cy.
1— 1000 KW West. 250 V. DC 60 cy.
1— 500 KW G. E. 250 V. DC 60 cy.
1— 200 KW G. E. 60 V. DC 60 cy.
1— 75 KW West. 125 V. DC 60 cy.
1— 75 KW Ridgway 115 V. DC 60 cy.
1— 75 KW Star 240 V. DC 60 cy.
1— 18 KW West. 60 V. DC 60 cy.

ROTARIES — 60 Cy.

1—2929/3705 KW Gen. Elec. 225/285 V.
1—2025/2565 KW Gen. Elec. 225/285 V.
1— 2000 KW Allis Chalmers 600 V.
1— 1500 KW Westinghouse 600 V.
2— 1500 KW Westinghouse 270 V.
2— 1000 KW General Electric 600 V.
1— 750 KW Westinghouse 275 V.
1— 500 KW Allis Chalmers 600 V.
1— 500 KW General Electric 275 V.

FREQUENCY CHANGERS

1—12500 KVA G. E. 25/60 cy. 300 RPM
1— 6250 KVA G. E. 50/60 cy. 600 RPM
2— 3000 KVA West. 25/60 cy. 300 RPM
1— 2500 KVA G. E. 25/60 cy. 300 RPM
2— 1000 KVA G. E. 25/60 cy. 300 RPM
1— 500 KVA Al. Ch. 25/60 cy. 300 RPM

TRANSFORMERS — 60 Cy.

3— 1000 KVA West. 66000-11000 V.
1— 2500 KVA Al. Ch. 33000-13800 V. 3 ph.
3— 667 KVA Pitts. 33000-11000 V.
3— 200 KVA West. 33000-2400 V.
3— 50 KVA G. E. 33000-2300 V.
3— 75 KVA Moloney 33000-2300/6900 V.
3— 667 KVA G. E. 33000-440 V.
3— 3750 KVA West. 26400/13200-2400 V.
1— 8000 KVA Penn Auto 26400/13200-2400 V. 3 ph.
4— 450 KVA Al. Ch. 25410/44000-13280/23000 Y
3— 667 KVA Wagner 23000-575 V. 25 cy.
6— 250 KVA West. 22000-2300/4150 V.
2— 4000 KVA Penn. Furnace 22000-228 V. 3 ph.
6— 3000 KVA Al. Ch. Furnace 13200-200 V.
2— 200 KVA G. E. 11500-220/110 V.
3— 200 KVA Moloney 11000-2300 V.
3— 167 KVA G. E. 7200/12400 Y—240/480 V.
1— 1500 KVA West. Auto 4000-2300 V. 3 ph.
1— 100 KVA G. E. 2300-575 V. 3 ph.
3— 250 KVA Al. Ch. 2300-480 V.
3— 20 KVA West. 2200-575/287½ V.
3— 7½ KVA G. E. 600-120/240 V.
12— 15 KVA Standard 450-117 Delta
2— 27½ KVA G. E. 440-220/110 V.

OIL CIRCUIT BREAKERS

2— 800 A. 87 KV Am. Brown Bev. Outdoor
1— 400 A. 37 KV West. G11 Outdoor
2— 1000 A. 23 KV Kelman CB76 Outdoor
4— 600 A. 15 KV G. E. FHK0138BS Outdoor

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & CO., INC.

50 Church Street — New York City 7 — New York

KEYSTONE OFFERS FROM STOCK

TRANSFORMERS

The following 3 transformers were used in one bank
1—333 KVA. Gen. Elec., 33000 x 13200/6600
2—500 KVA. Pittsburgh 330 x 13200/6600

3—400 KVA Westgh. 13200 x 240
2—200 KVA. Packard 2300 x 115/230
3—150 KVA. Pittsburgh 2300 x 230/460
2—150 KVA. Pittsburgh 2300 x 115/230
4—100 KVA. Gen. Elec. 2300 x 115/230
Other sizes in stock in various voltages.

TURBO GENERATORS

1—500 KW., 3 ph., 60 cy., 440 volt to Gen. Elec. turbine #39937. With condensor switchboard etc. Very modern unit.
1—500 KW., 3 ph., 60 cy. Gen. Elec. non condensing.
1—750 KW., Gen. Elec. automatic extraction.

MOTOR GENERATORS

1—105 KW., 1500 amp., 70 volt to 150 HP., 3 ph., 220/440 volt, 1165 RPM, ball bearing Electric Products Co. set.
1—1000 amp., 80 volt Burke with 3 ph. syn. motor.

MOTOR GENERATORS (Cont'd)

1—75 KW., 250 volt, 1200 RPM., 3 ph., 60 cy., 440 volt syn. motor, Star Electric Co.
1—50 KW., 250 v., Louis Allis to 75 HP., 220/440 volt type I-K Gen. Elec.
1—15 KW., 250 v. Westgh. SK to 3 ph., type CS motor.

CAPACITORS

8—180 KVA. Westinghouse, interteen, 3 phase, 60 cycle, 460 volt.
6—120 KVA. Westinghouse, interteen, 3 phase, 60 cycle, 460 volt.
11— 90 KVA. Westinghouse, interteen, 3 phase, 60 cycle, 460 volt.
3— 90 KVA. General Electric, Pyracol, 3 phase, 60 cycle, 460 volt.

MISCELLANEOUS

2—25 KVA., 1 ph., 60 cy., 120 or 240 v. Westgh. to 4 cylinder LeRoi engines, with panels.
1—150 KW., 125 volt Crocker Wheeler generator to 4 cylinder vertical Ames steam engine.
1—1000 HP., Gen. Motors Diesel Engine to 600 KW., 500 volt, 750 RPM. Westgh. generator.

Send for our catalogue of A.C. & D.C. motors, A.C. & D.C. Generators, transformers, starters, and other related equipment.

KEYSTONE POWER PLANT EQUIPMENT CO.
8403 HEGERMAN STREET — HOLMESBURG, PHILADELPHIA 36, PA.

MODERN EQUIPMENT

65 ton Whitcomb diesel elec. locomotive.
30 ton Plymouth gasoline locomotive.
2200 ft. Chicago Pneu. Air Compressor. New 1942.
25 ton Steel Stiffleg Derrick and Hoist.
2-450 HP Fairbanks Morse 300 KW diesel engine generator sets.
2500 KW General Electric 2300 volt condensing turbine generator set.
2-500 HP B&W 250 lb. Watertube Boilers.

Many other items of Power, Railroad and Industrial equipment.

Mississippi Valley Equipment Co.
507 Locust St., St. Louis 1, Mo.

COMPRESSORS—VACUUM PUMPS
NEW and GUARANTEED REBUILTS

SPECIALS

7/3½x7 Chicago T-CB 105 CFM 350 LBS
22x9 Ingersoll Rand, ES Vacuum Pump 1183 CFM
9/4x9 Ingersoll Rand, ES2, 191 CFM 350 LBS
9-10 x 9 Ingersoll Rand, FS1, 242 CFM 75 LBS
10x9 Ingersoll Rand, ES1, 262 CFM 75 LBS

Any Make—Any Size—We Can Help You, Portable or Stationary

American Air Compressor Corp.
Dell Ave. and 47th St., North Bergen, N. J.

NEW MOTORS AND CONTROLS AT REDUCED PRICES!

SLIP RING
220/440 VOLT

Qu.	HP	SPEED	MFG
1	100	720	ELLIOTT
2	125	720	ELLIOTT
1	150	720	ELLIOTT
2	500	1200	ELLIOTT

NEW C-H CONTROLS FOR EACH OF ABOVE

SQUIRREL CAGE
220/440 VOLT

Qu.	HP	SPEED	MFG
2	60	1200	A-C TEFC
2	75	1800	A-C TEFC
*1	125	600	E-M BALL
*1	350	900	WHSE-CS

* 2300 Volt.

D. C. MOTORS
230 VOLT

Qu.	HP	SPEED	MFG
6	5	1750	REL 23-T
3	10	1750	REL 34-T
1	15	300/1200	L-A
5	35	850	REL 230-T
6	75	1750	F-M DX

RECONDITIONED AND GUARANTEED

SLIP RING

Qu.	HP	RPM	MFG	VOLTS
1	40	1200	A-C	440
1	100	1800	A-C	440
1	100	600	G.E.	440
1	250	600	WHSE	2300
2	350	450	WHSE	2300
1	600	514	C-W	440

SQUIRREL CAGE

Qu.	HP	RPM	MFG	VOLTS
10	20	1800	REL	220/440
2	50	900	G.E.	220/440
1	75	1200	IMP.	440
1	75	1800	IDEAL	2300
1	125	600	WHSE	2300
1	150	720	WHSE	4160
1	300	720	A-C	440

D. C. MOTORS 230 V

Qu.	HP	RPM	MFG	
3	15	400/1600	REL	BALL
2	40	500/1500	C-W	BALL
1	50	300/1200	REL	PLANER
1	60	300/1200	G.E.	RF-17
2	75	500/1500	C-W	BALL
2	125	400/1200	REL	1050-T
1	250	275/690	GG	RF

SYNCHRONOUS

Qu.	HP	RPM	MFG	VOLTS
1	200	720	G.E.	440
1	225	450	E-M	2300
2	250	360	G.E.	2300
1	300	514	E-M	440
1	350	200	WHSE	2300
1	600	450	G.E.	2300

M-G SETS

Qu.	KW	D.C.	MFG	A.C.
21	5	250	REL	440
15	3	250	REL	220
1	100	250	G.E.	2300
1	300	250	C-W	2300
1	300	600	G.E.	2300
1	500	600	G.E.	4160

REDUCERS—NEW

Qu.	MFG	HP	TYPE	RATIO
6	FALK	5	28DU	10:1
2	FALK	10	34DU	10:1
1	ABART	12	6A	18.5:1
2	FOOTE	15	60DX	10:1
1	AM.ENG.	50		16:1

MAGNETIC SLIP RING CONTROLS—NEW

15 — 250 HP 440 V. ALLIS, REVERSING, STARTING OR REGULATING DUTY WITH 600A. AIR CKT BRKR.

CONTROLS

WE CAN BUILD ALL TYPES OF A.C. AND D.C. CONTROLS, MAGNETIC OR MANUAL — TO YOUR SPECIFICATIONS.

HYDRAULIC PUMP 250 GPM 1500 LBS.

BETHLEHEM HORIZONTAL TRIPLEX WITH 440 OR 2300 VOLT MOTOR AND MAGNETIC STARTER — EXCELLENT.

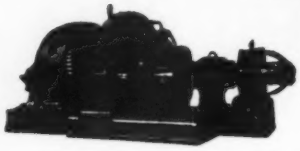
The Boswick Electric Co.

P. O. BOX 55, AKRON 9, OHIO • Phone WAlbridge 1195

Buy from Boswick with confidence!

EVERYTHING YOU'RE LOOKING FOR IN . . .

ELECTRICAL POWER EQUIPMENT



A COMPLETE STOCK OF GUARANTEED "REBUILTS"

Special Offering

MOTOR GENERATOR SETS

1000 KW generator, General Electric type MPC, compound interpole, 275 volts, 514 RPM, direct connected to, 1120 KVA synchronous motor, General Electric, type TS, 3 phase, 60 cycle, 4600 volt, 514 RPM, on fabricated steel sub-base. Complete.

500 KW generator General Electric, type MPC, compound interpole, 250 volts, 720 RPM, direct connected to, 710 HP synchronous motor, General Electric, Type ATI 3 phase, 60 cycle, 440 volts, 720 RPM, 3 bearing unit, on fab. steel sub-base.

POWER FACTOR CORRECTOR

M.G. Set, consisting of 1563 KVA AC gen 3/60/2300 900 RPM and Syn. motor 3/60/2300 900 RPM

VARIABLE VOLTAGE DRIVES

M.G. SET. 200 KW DC generator, General Electric, type MPC, 250 volts, 800 amps, 1200 RPM, direct connected to 300 HP synchronous motor, General Electric, type TS, 3 ph., 60 cy., 440 volt, .8 P.F. 1200 RPM.

D.C. Motor 250 HP General Electric type MPC, form A, 245 volts, 730-975 RPM. With Complete Starting and Control Panels.

BOILER

565 HP Springfield 160 lbs. NEW 1936 like new with Stokers, coal elev. bunker forced draft, blowers, etc.

TURBINE

312 KVA Cr. Wheeler 3/60/240 1200 RPM thru gear to Moore turbine 425 lbs. exh. 10#.

MOTOR-GENERATOR SETS

KW	Make	Volts AC	Volts DC
1200	Al. Chlrs.	3/60/4000	600
1200	Gen. Elec.	3/60/5000	125/250
1000	Gen. Elec.	3/60/440	250
1000	Gen. Elec.	3/25/2300	250
500	Gen. Elec.	3/60/440	250
500	Gen. Elec.	3/60/2300	600
450	Gen. Elec.	3/60/2300	125/250
200	Gen. Elec.	3/60/2300/440	250
200	Cr. Whlr.	3/60/2300	125
150	Al. Chlrs.	3/60/220	125
125	Gen. Elec.	3/60/440	125
90	Gen. Elec.	3/60/2300/440	90
75	Gen. Elec.	3/60/2200/440	125
75	Gen. Elec.	3/60/2200/440	250
75	Star	3/60/440	250
60	Westghse	3/60/440	250
60	Al. Chlrs.	3/60/220	110
60	F. Morse	3/60/220	125
50	Gen. Elec.	3/60/440	250
50	Westghse	3/60/440	110
40	Cr. Whlrs.	3/60/220	125
40	Westghse	3/60/220	125
40	Reliance	3/60/440	230
40	Cr. Whlrs.	3/60/440	125
25	Wotton	3/60/220	110
15	Westghse.	3/60/440	250
10	Hertner	3/60/220	90/108
10	Reliance	3/60/440	250

SQUIRREL CAGE MOTORS

HP	Make	Type	Volts	Speed
700	Gen. Elec.	K	2200	1800
500	Gen. Elec.	K	440	3600
500	Gen. Elec.	KTP	440	1800
400	Al. Chlrs.	Spl. pf.	2300	900
400	Gen. Elec.	I.K.	2200	1800
400	Westghse	C.S.	2200	1800
350	Westghse	C.S.	2200	900
300	Gen. Elec.	I.K.	440	900
250	Gen. Elec.	I.K.	2200	900
250	Westghse	C.S.	2200	1800
200	Wagner	26v	440	1800
200	Gen. Elec.	K	2300	720
200	Gen. Elec.	K.F.	2200	705
200	Gen. Elec.	TEFC	2200	1800
200	Westghse	C.S.	440	720
150	Gen. Elec.	K.T.	2300	600
150	Cont.	TEFC	440	900
125	Westghse	C.S.	440	3600
125	Gen. Elec.	TEFC	440	1200
100	Al. Chlrs.	A.R.	440	514
100	Al. Chlrs.	A.R.	440	900
100	U.S.	Vert.	440	1200
100	Burke	E.M.	440	1200
75	Triumph	T.E.	2200	514
75	Gen. Elec.	I.K.	440	720
75	Gen. Elec.	F.T.	440	720
75	Westghse	Vert.	2200/440	900
75	Gen. Elec.	K	220/440	1200
75	Gen. Elec.	TEFC	440	1200
75	Al. Chlrs.	A.N.	440	1200
75	Al. Chlrs.	A.R.	2200/440	1800
60	Al. Chlrs.	A.R.	440	514
60	Gen. Elec.	KG-exp.	440	1200
60	Gen. Elec.	K	440	1800
60	Gen. Elec.	TEFC	440	1800
60	Gen. Elec.	K-444	440	1800

First Source for 39 Years for Quality Electrical Power Equipment

CHICAGO ELECTRIC COMPANY

1320 WEST CERMAK ROAD • CHICAGO 8, ILLINOIS • PHONE: CANAL 6-2900

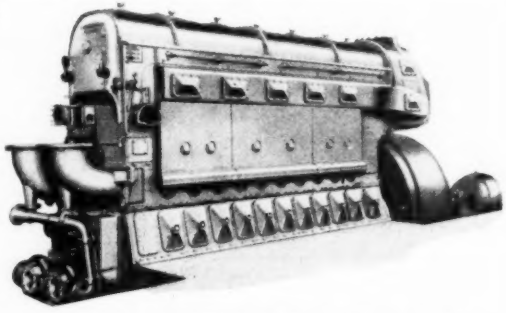
DIESEL ENGINE GENERATORS

Immediate Delivery

2—Fairbanks Morse O. P. MOD 38D8⅛—1600 HP direct connected to Fairbanks Morse 1420 KVA—1136 KW—3 Ph—60 CY—2300/4000 Volt—720 RPM Alternaters with 10 KW direct connected Exciters.

3—Fairbanks Morse O. P. MOD 38D8⅛ 1600 HP direct connected to Crocker Wheeler 1250 KVA—1000 KW—3 PH—60 CY—2300/4000 Volt—720 RPM Alternaters with 10 KW direct connected Exciters.

5—General Motors MOD 3-268A—150 HP, direct connected to Westinghouse 100 KW—3 PH—60 CY—480 Volt—1200 RPM Generators with direct connected Exciters.



2—ALCO (McIntosch & Seymour) 900 HP type 6—12½ x 13—T, direct connected to GE-620 KW, 240 volt D. C. 700 RPM generators with direct connected exciters.

2—General Motors MOD 3-268A—150 HP direct connected to Delco 100 KW—120/240 Volt, 1200 RPM 3 wire DC Generators.

WALTER H. WILMS & COMPANY

2526 GUARDIAN BUILDING DETROIT 26, MICHIGAN

Phone: Woodward 1-1856 and 1-1857

MOTOR GENERATORS

500 KW G. E. Syn. 600 V. DC, 900 RPM, 440/2300/4000/6900 V. AC, 3 P., 60 C.

400 KW West. Syn. 600 V. DC, 720 RPM, 2300/4000 V. AC, 3 P., 60 C.

300 KW G. E. Syn. 250 V. DC, 1200 RPM, 2300/4600 V. AC, 3 P., 60 C.

300 KW Rdwy. Syn. 250 V. DC, 1200 RPM, 2300/4000 V. AC, 3 P., 60 C.

150 KW G. E. Syn. 250 V. DC, 1200 RPM, 2300/4000 V. AC, 3 P., 60 C.

•

SYNCH. CONVERTER

300 KW G. E. 600 V. 6 P., 60 C., 1200 RPM. 2300/4000/6900/13,200 V. Trans.

WALLACE E. KIRK COMPANY
502 Grant Building, Pittsburgh, Pa.

NELSECO DIESEL SET

1000 KW Diesel generating set, 6 cyl., air start, Bosch injection system, Nelseco Diesel engine, 300 RPM, direct coupled to: General Electric 1000 KW 3 phase, 60 cycle, 2300 volts complete with starting auxiliaries, switchboard and spare parts.

IMMEDIATE DELIVERY

ALJON ELEC. DIESEL CO.
904 Pacific St., Brooklyn 16, N. Y.
STerling 3-6515

TRANSFORMERS FOR SALE

3— 3 KVA W-H 13200-120/240
12— 5 KVA W-H 13200-120/240
4— 10 KVA W-H 13200-120/240
3— 25 KVA W-H 13200-120/240
3— 25 KVA Mol 13200-120/240
10—37½ KVA W-H 13200-120/240
2— 25 KVA W-H 13200-2400
2—37½ KVA Mol 13200-2400/4160Y
3— 75 KVA W-H 13200-120/240
3— 75 KVA G-E 13200-120/240
1— 75 KVA Mol 13200-2400
1— 100 KVA W-H 13200-2400
10— 1½ KVA Wag 7200-120/240 "REA"
4— 5 KVA W-H 2400/4800-120/240
4— 7½ KVA W-H 4800/8320Y-120/240
3— 50 KVA W-H 4800/8320Y-120/240
3— 50 KVA G-E 26400-2300/4000Y
3— 50 KVA G-E 33000-2400/4160Y
3— 100 KVA G-E 33000-2400/4160Y
1—Gas Fired Recirculating Young Bros. DRYING OVEN, 2 Compts. complete with controls.

TRANSFORMERS WANTED

Rewind and repair service on all makes of transformers.

THE ELECTRIC SERVICE CO.
Cincinnati 27, Ohio

ELECTRICAL EQUIPMENT — REBUILT and GUARANTEED

MOTORS—GENERATORS—MG SETS—TRANSFORMERS—CONTROLS

PROMPT SHIPMENT—PARTIAL LISTING

SLIP RING MOTORS—3 Ph., 60 Cy.

Qu.	H.P.	Speed	Volts	Make	Type
6	7½	810	550	G.E.	MTC-5201
1	7½	575	220	G.E.	MT-522
2	10	1140	440	West.	HF-7A
2	10	570	220	G.E.	HI-11
2	11‡	810	550	G.E.	ITC-8008
2	15	1160	440	West.	CW-464C
2	15	570	220	West.	CW-646
1	15	680	440	West.	NW-316
1	20	880	440	West.	CW-638
1	25	1130	550	G.E.	MT-323
2	25	850	220	Wagner	BR
2	25	720	440	Wagner	22VBR
1	30	1130	440	G.E.	MT-326
1	30	865	440	West.	CW-646
1	30	850	440	G.E.	MT-332
1	30	675	440	G.E.	MT-336
2	35	600	440	F-M	HV-H16A
2	40	865	2200	Al.-Ch.	ARY-223C
1	40	560	440	G.E.	MT-346
2	50	1150	440	G.E.	M-536
1	50	859	440	West.	HF-12A
1	50	570	440	G.E.	MT-552
5	52‡	550	220	G.E.	IQC-5013***
1	60	685	440	West.	CW-758
1	60	570	550	G.E.	MTC-5546
1	60	45	550	West.	CW
1	80‡	575	440	G.E.	MTC-5352
2	125	430	440	G.E.	IL-16
2	150	1750	440	G.E.	MTP-549
1	175	505	550	West.	CW-1002
2	200	600	550	G.E.	IM-17
1	200	495	2200	G.E.	IM-17A
1	250**	296	220/ 380††	West	CW-20-53-15
3	300	900	140	G.E.	IM-17
2	300	600	2200	G.E.	IM-17A
1	300**	360	440	West.	CW-20-53-15
2	350	880	2200	G.E.	IM-17A
1	400	505	550	West.	CW
1	600	1770	440	G.E.	IM-E15C
1	650**	360	440	G.E.	MT-442Y
1	700	735	4000‡‡	West.	CW

All 220 volt motors can be reconnected for 440 volts.
‡ Intermittent rating. *** 2 phase.
** New. †† 50 Cycle. ‡‡ 25 Cycle.

230 Volt Constant Speed D.C. Motors

Qu.	H.P.	Speed	Make	Type
22	2	850	West.	SK-20
20	3	1150	West.	SK-20
10	3	850	Reliance	Y-23T
25	3½	850	West.	SK-30
2	7½	1150	G.E.	CDM-6a
2	7½	850	G.E.	CD-75
10	10**	1750	Kimble	BA-324
5	10**	1150	Al.-Ch.	EB-80
2	10	850	West.	SK-83
10	13½**	600	West.	SK-93
3	15	1750	G.E.	CD-75
5	15	825	West.	SK-90
1	20	1750	L.A.	ONA-L851
1	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-30
11	20	750	West.	SK-1101
17	25	825	West.	SK-120
2	30	1100	G.E.	RC-12
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	750	West.	SK-150
1	50	650	G.E.	RC-16
1	60	1750/1310	West.	SK-143
1	150	700	Al.-Ch.	
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101A

230 VOLT ADJ. SPEED D.C. MOTORS

10	1½/2	500/200	G.E.	CD-65
1	2	225/900	Reliance	PST
1	5	450/1800	G.E.	CD-83
2	6	450/1800	G.E.	RF-9
6	5/7½	600/1800	G.E.	RA-30
1	10	400/1600	Reliance	T-92T
1	12½	280/840	West.	SK-130
10	12½**	600	West.	SK-93
1	15	600/1200	West.	SK-100L
1	20	500/1500	G.E.	RF-11
1	20/25	400/1600	Reliance	T-230-T
1	20/25	300/1200	West.	SK-153
1	25	400/1600	G.E.	RF-13
1	25	500/1500	G.E.	RF-12
1	25/29	300/1200	G.E.	RF-13
1	30	400/1200	West.	SK-163
1	30/40**	400/1600	G.E.	CD-1236
1	35	500/1800	West.	SK-143
1	40/50	400/1600	Al.-Ch.	ED-147
1	75	500/1500	Cr.-Wh.	CCM
1	75	375/750	Cr.-Wh.	CMC-125H
8	100	225/900	G.E.	MPC-A
5	100	400/1200	Al.-Ch.	
1	100	320/960	West.	SK-200
1	125	450/1000	West.	SK-190
1	175	230/500	West.	SK-220
2	375	350/500	G.E.	MPC

** New.

VARIABLE VOLTAGE DRIVES

40 HP. Reliance, Variable Voltage Drives, each Consisting of:
1—40 KW 250 Volt, Induction M-G Set, with two auxiliary 5 KW generators and exciter.
1—40 HP 400/1500 RPM, Frame 385T, 230 Volt, DC Motor.
With full magnetic control providing jog forward, jog reverse, run, fast, slow, and stop, and motor operated field rheostat.

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.

Totally Enclosed Fan Cooled, Ball Bearing

Qu.	H.P.	RPM	Volts	Make	Type & Frame
2	½	1750	220	R&M (TE)	L-184
1	½	1725	440	G.E.	K-63
4	1	1140	220	Howell	A-204
4	1.5	1150	220	L.A. (TE)	18-225
5	1.5	1140	440	West.	CS-225
1	2	1735	220	G.E.	K-224
4	2	1140	220	L.A.	JS-225Y
1	2	1100	440	West.	CS-225
2	3	1160	440	L.A.	JS-254
1	5	3480	220	G.E.	K-225
2	5	1750	440	L.A.	JA-254
10	5	1730	440	G.E.	K-254
1	5	1720	440	Century	SCH-254
2	5	1165	440	L.A.	JA-284
5	7.5	1740	440	G.E.	K-284
1	7.5	1735	220	G.E.	KF-284
1	10	3480	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	10**	880	220	West.	CS-365-EXPF
1	15	1745	440	West.	CS-326
1	15	1175	440	L.A.	JA-365
1	20	1760	220	G.E.	K-364
1	25	1760	220	G.E.	K-365
1	25	1200	550	G.E.	K-405
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W504

Splashproof, Ball Bearing

1	2	1735	440	G.E.	K-224
1	3	1160	440	L.A.	FS-254
23	5	1750	440	L.A.	FS-254
1	5	1735	220	G.E.	K-254
1	5	1160	440	L.A.	FX-284
1	10	3480	440	L.A.	KS-254
1	15	1175	440	L.A.	JA-365
4	15	1150	440	L.A.	FX-365
2	40	1175	220	G.E.	K-445
3	50	1760	440	L.A.	FX-445A
5	50	1160	220	G.E.	K-504
1	125	1770	440	L.A.	FX-1078Y
1	150	1775	440	L.A.	FX-1168
3	150	880	440	L.A.	FX-1368
1	150	700	440	G.E.	KF-6335
1	200	885	440	L.A.	FS-1378

Open Type Motors

Qu.	H.P.	Speed	Volts	Make	Type
8	2	1170	440	G.E.	KT-920
4	2	1160	440	West.	CS-93C
1	2	690	440	G.E.	KT-944
10	5	1740	440	West.	CS-232C
1	7½	3475	440	West.	CS
1	7½	1750	440	West.	CS-250C
3	7½	1165	440	G.E.	KT-952
2	7½	870	440	West.	CS-370C
5	10**	1760	440	L.A.	OGA-324
5	10**	1750	440	West.	CSP-324
3	10	1160	440	West.	CS-370C
1	10	885	440	G.E.	KT-502
1	15	3485	220	Reliance	AA-B3247
5	15**	1735	440	Century	SC-326
1	15	1200	220	G.E.	KT-502
1	15	900	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
5	20**	1750	440	Wagner	RPB-364
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KF-512
2	20	900	220	G.E.	FTR-522
1	25	1800	220	G.E.	KT-4312
5	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-867C
1	25	900	220	Howell	HCBR-356***
2	25**	875	440	Master	PB-405
2	25	575	440	G.E.	KT-542
1	30	1160	440	West.	CS-844
1	30	870	440	West.	CS-846
1	40**	3545	220	G.E.	KF-4048
2	40	1750	440	West.	CS-883C
2	40	900	2300	G.E.	FTR-536
4	50**	1750	440	Wagner	RPB-405
1	50	850	220	West.	CCL
2	60**	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-346
1	75	1160	440	West.	CS-862C
1	75	870	220	West.	CS-766A
2	75	885	2300	G.E.	KT-852
1	100	690	220	West.	C
1	100	580	2200	G.E.	TK-15A
2	100	500	2200	West.	CS-930
1	100	495	2200	Al.-Ch.	AN
2	125	435	440	Al.-Ch.	AR
2	125	400	2300	G.E.	T-17-FR
1	200	580	550‡‡	G.E.	KT-4568
1	600	1200	440	G.E.	KTP-567
1	700	1800	2300/4000	West.	CS-4-39D-12

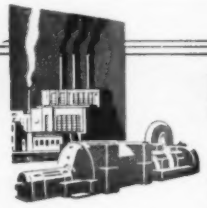
All 220 volt motors can be reconnected for 440 volts.
** New *** 2 Phase.
‡‡ Reconnectable for 440 volts.

CRANE, MILL TYPE, 230 V. D.C. MOTORS

Qu.	H.P.	Speed	Make	Type
2 (115 v.)	3½	700	G.E.	CO-1803
2	5½	760	West.	MCB-20
1 (new)	6/ 7	1050/900	West.	K-2
1 (new)	10	650	G.E.	MD-403-BE
3	25	590	Diehl	TE
2	27½	535	West.	K-7
2	35	750	G.E.	CO-1828
3 (new)	35	600	West.	CK-9
1	50	750	G.E.	CO-1829A
1	50	600	West.	CK-9
4	50	525	G.E.	CO-1830
1	50	470	G.E.	CO-2007
2 (new)	60	550	G.E.	COM-1831 AE

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment Is Located in Our Cleveland Warehouse. We Have Controls for Most Items Listed.

ELECTRIC GENERATOR & MOTOR CO.
4521 HAMILTON AVE. CLEVELAND 14, OHIO



POWER EQUIPMENT

Outline specifications on some of the better machinery now available. If additional information would be useful, or if you want to arrange inspection, please wire or phone collect.

TURBO GENERATORS (ISP: 125# 486° to 600# 750° FTT)

ITEM NO.	QUANTITY & CAPACITY	
51	1250 KW	125# 486° ISP, 600 volt, CONDENSING. All auxiliaries, 1920.
62	300 KW	150# 486° ISP, 120/208 volt, CONDENSING. All auxiliaries, 1927. **Factory rebuilt and rewound 1940.**
432	500 KW	150# 486° ISP, 480 volt, EXTRACTION @ 15#G.
740	1000 KW	150# 486° ISP, 2400 volt, EXTRACTION: 38,600# /hr. @ 10#G, 1927.
16	1250 KW	200# 486° ISP, 2400 volt, CONDENSING. All auxiliaries, 1924.
1049	2000 KW	175# 486° ISP, 2400 volt, CONDENSING. All auxiliaries, 1918. Entirely overhauled and rebuilt 1940. In all critical and moving parts it shows 5 years' normal wear. Heavy 3rd stage wheel installed. Total log record 8 years.
1887	3000 KW	200# 486° ISP, 2400 volt, CONDENSING. All auxiliaries, 1919.
1544	1000 KW	250# 550° ISP, 2400 volt, NON-CONDENSING @ 50#G, 1925.
1038	1500 KW	250# 550° ISP, 2400 volt, CONDENSING, 1927.
601	2500 KW	250# 550° ISP, 2400 volt, EXTRACTION: 90,000# /hr. Max. @ 15#G. Built 1927. Good condition. Some spare blading.
60	(2) 1000 KW	150# 600° ISP, 480 volt, CONDENSING. All auxiliaries, 1929.
1625	1000 KW	250# 600° ISP, 2400 volt, CONDENSING. All auxiliaries, 1925.
603	2500 KW	250# 650° ISP, 2400 volt, CONDENSING. All auxiliaries, 1924.
1806	1250 KW	400# 650° ISP, 2400 volt, EXTRACTION @ 160#G. (Available with this is a 1000 KW, 160# ISP, 52G, extraction machine).
1475	4000 KW	600# 750° ISP, 13.8 KV, MAX. THROTTLE FLOW: 95,000# /hr. AUTOMATIC CONTROLLED EXTRACTION: 45,000# /hr. @ 125#G. (Can modify 125# to 150#) and BACK PRESSURE @ 20#G (Can modify 15# to 25#). Minimum to exhaust @ max. extraction: 5000# /hr. Complete except switchgear. New—never installed.

SPECIAL

ITEM NO.	QUANTITY & CAPACITY	
1555	6000 KVA	210# 590° ISP, 2400 volt, Condensing. All auxiliaries. Factory rebuilt for this steam condition. Carefully and fully maintained. (Photo and full data on request).

TURBO ONLY

ITEM NO.	QUANTITY & CAPACITY	
953	2000 KW	185# 590° ISP, Non-Condensing @ 40#G, 3600 RPM, 1935. Replaced by extraction machine. Rated 2000 KW maximum.

BOILERS

3	750 HP	250# D & S, Union Type N. Underfeed stoker fired, 1927.
601	418 HP	400# 100° SH, B & W, Pulverized coal fired, 1940.
1864	700 HP	450# 600° FTT, C.E. Co. Chain grate stoker fired. All controls. 60,000# /hr. each.

TRANSFORMERS 1 PH.

794	(2) 2000 KVA	27 KV Primary, 2300 and 480. Rated 1500 KVA at 2300 and 5000 KVA @ 480.
1814	(2) 2000 KVA	23 KV (4-2½% taps above and below) Primary. 2300 Secondary. Less than one year service.

TRANSFORMERS 3 PH.

1856	2500 KVA	13.2 KV Primary, 6.6 KV Secondary (with two 10% taps below).
669	(7) 1000 KVA	11.5 KV Primary, 480 V Secondary. Pyranol filled.
1515	(5) 7500 KVA	33 KV Zig-Zag Primary, 13.8 KV Secondary (Reconnectable to 6.9 KV).

FURNACE TRANSFORMERS

345	4000 KVA	(3 ph) 24 KV (with 2-10% taps below) Primary. 228/92 (in 12 steps) Secondary. Transformer 5%, Reactor 30% Reactance. Built 1942. Used 2 years.
1521	(6) 3000 KVA	(1 ph) 13.2 KV pri, 240/160 (6 taps) Secondary.
686	(3) 8000 KVA	(3 ph) 11 KV Primary, 100/160 Secondary.
673	1000 KVA	(3 ph) 7.2 KV (with 1-10% tap above and 2 below) Primary. 214/125/94 Secondary. 1934.
601	1200 KVA	(3 ph) 12 KV Pri. 190/87 (8 taps) Secondary. 1931.
350	200 KVA	(3 ph) 220 V Primary. 120/60 Secondary. New.

MOTOR GENERATOR SETS

607	1000 KW	250 Volt D.C. 2400 volt A.C. 514 RPM.
641	300 KW	250 volt D.C. 2400 volt A.C. 1200 RPM. Rebuilt & guaranteed.
1415	300 KW	250 volt D.C. 480 volt A.C. 1200 RPM. Rebuilt & guaranteed.

ROTARIES

801	(2) 1500 KVA	275 volt D.C. 13.8 KV A.C.
816	2925/3705	222/285 volt D.C. 13.8 KV A.C. Syn. booster.

PAUL STEWART

UNION TRUST BUILDING • CINCINNATI, 2 OHIO

MAin 5873
MAin 3427

Memo to "P.E." (POWER ENGINEER)

You don't have to "Shop Around" For what you need . . .

Buy direct from one of the largest stocks of Electrical Equipment in the East.

JUST A FEW OF THE MORE THAN 35,000 ITEMS

- 1—400 KW Motor Generator Synch. Driven 250/120 volts DC
- 10—1000 & 1500 Amps Multi-Arc Welding Generators AC Motor Driven
- 2—200 KVA A.C. Generators 600 rpm
- 1—219 KVA A.C. Generator 257 rpm
- 4—25 KVA 3 PH Generators Driven by 20 HP DC 1800 rpm 230 Volt, Motors NEW
- 1—100 HP Electro Dynamic 1800 rpm 230 volt DC Motor
- 3—150 HP Crocker Wheeler 900 rpm 230 Volt DC BB TEFC Motors
- 2—250 HP G.E. 3 Ph. 60 Cy. 440 Volt 1800 rpm Motors
- 1—200 HP G.E. 3 Ph 60 Cy 2300 Volt 257 rpm Synch. Motor
- 1—450 HP West. 3 Ph 60 Cy 440 Volt 500 rpm Slip-ring Motor
- 1—300 KW DC 240/120 Volt Diesel Driven Generator
- 4—100 KW DC 240/120 Volt Diesel Driven Generators

STOCK LIST AND QUOTATIONS ON REQUEST

Immediate Shipment from 3 Warehouses

ALL EQUIPMENT REBUILT TO N.I.S.A. STANDARDS

EMPIRE ELECTRIC CO., INC.
87-93 JAY STREET · BROOKLYN 1, N. Y.

TEL.- MAIN 4-6868

POWER PLANT MACHINERY

Actual Photograph

500 KVA SKINNER UNIFLOW ENGINE GENERATOR UNIT

500 KVA General Electric Generator, 3 phase, 60 cycle, 460/230 volts, 150 RPM, direct connected to Skinner Universal uniflow engine, 130-160# steam pressure, 0-5# back pressure. Excellent condition, can be shown in operation.

TURBO GENERATORS
3 phase 60 cycle

6000 KVA (2) G.E., 4160/2400 volts, 600# steam, condensing.
5000 KVA G.E., 13800 volts, 600# steam, 135# extraction, 25# exhaust.

UNIFLOW UNITS
3 phase 60 cycle

500 KVA Skinner, 450 volts, 130-160# steam, 0-5# exhaust.
250 KVA (2) Skinner, 450 volts, 110-175# steam, 0-5# exhaust.

MERCURY ARC RECTIFIERS
3 phase 60 cycle

4500 KW (3) Allis Chalmers, 600 volts DC., 13,800 volts A.C.

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. Telephone: MAin 9514 CLEVELAND 14, OHIO

MOTORS • GENERATORS • TRANSFORMERS

MOTORS
3 PHASE—25 CYCLE—220/440 VOLTS

H.P.	Make	Type	Frame	RPM
50	Fairbanks Morse	H16B	Ball Bearing	750
75	Fairbanks Morse	H16C	B.B. Slipring	720
75	Gen. Elect.	IK	2200 volt	750
75	Gen. Elect.	IK		1500
100	Allis Chalmers			1450
150	Gen. Elect.	IK-17		365
150	Gen. Elect.	IK-16		480
150	Gen. Elect.	IM-16	Slip Ring	480
150	Allis Chalmers			1450
150	Gen. Elect.	KT	557	1455
400	Gen. Elect.	IM 17A	Slip Ring	730
500	Gen. Elect.	IK		485
600	Gen. Elect.	MT	Slip Ring	490
600	Westinghouse	CS		490

MOTOR GENERATOR SETS

2—350 KW General Electric Sets 250 Volts D.C. driven by 500 HP, 3 Phase 25 Cycle motors
—Will rewind for 60 Cycle operation.

3000 CYCLE MOTOR GENERATOR SET

GENERATOR—175 KVA General Electric A.C. Generator, type A.S.C. form AL, single phase, 800 volts, 3000 cycle, 1800 RPM, serial #5513639.
GENERATOR EXCITER—1 KW, General Electric Generator, type EF, form EB, 125 volts, D.C., 1800 RPM, 8 amps., serial #1758709.
MOTOR—300 HP, General Electric synchronous motor, type 7S, form EL, 3 P.F. 3 phase, 60 cycle, 440 volts, 1800 RPM, serial #5513638.
MOTOR EXCITER—3 KW, General Electric Generator, type EF, form EB, 125 volts, DC, 1800 RPM, 24 amps., serial #1758730.
Motor and Generator are direct connected, 4 bearing. Mounted on factory fabricated base, with direct connected exciters.
3000 Cycle Control is mounted in cubicle also containing 300 HP General Electric synchronous motor starting control.

FREQUENCY CHANGERS

All Sizes in Stock, 60 cycle to 90 cycle, 100 cycle, 120 cycle, 180 and any other high cycle if desired.

HORIZONTAL & DUPLEX
Compressor & Vacuum Pumps after Coolers, Filters

25 CYCLE MOTORS

1—1370 HP. Gen. Elect. Synchronous Motor Type A.T.I. 3/25/2200 Volts 150 RPM.
1—1900 HP. Gen. Elect. Synchronous Motor Type A.T.I. 3/25/2200 Volts 150 RPM.

NEW TRANSFORMERS

3—25 KVA Niagara O.I.S.C. 2400/120/240 1 Phase 60 cycle with taps
3—37½ KVA Niagara O.I.S.C. 2400/120/240 1 Phase 60 cycle with taps.
6—50 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—75 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—100 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—100 KVA Niagara O.I.S.C. 2400/120/240 1 Phase 60 cycle with taps.
3—150 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
6—200 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—250 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—333 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.

REBUILT TRANSFORMERS

Qu.	KVA	Make	Cycle	Voltage
3	50	Pitts.	25	11000/2300
2	50	Kuhlman	25	11500/2300/230/460
1	50	Kuhlman	25	11500/115/230
2	50	G. E.	60	2400/120/2400
1	100	G. E.	25	4600/230/460
3	400	Pitts.	25	12000/110

NEW MOTORS

300 New Gen. Elect. & Westinghouse Motors in stock from 1 to 100 H.P.

100 KVA TRANSFORMERS

3—100 KVA Gen. Elect. Transformers. Type H Form KF—2400/4160 volts primary 120/240 volts secondary. Price $150.00 each. Electrically O. K. F.O.B. truck, Minnesota.

MOTORS

1—75 HP. Fynn-Weischel Synn. 3/60/440/1200 RPM.
1—100 Gen. Elect. Slipring Type I Form M., 3/60/440/900 RPM.
1—100 HP. Gen. Elect. Type K (New Motor) 3/60/440/1800 RPM.
1—100 HP. Westinghouse Slipring Type CW, 3/60/440/435 RPM.
1—100 HP. West. Slipring Type CW 3/60/440/1200 RPM.
1—100 HP. Gen. Elect. Slipring 3/60/440/1200 RPM.
1—200 Gen. Elect. Type KT. 572 3/60/440/600 RPM.
1—200 HP. Gen. Elect. Slipring Type I Form M. 3/25/440/500 RPM.
1—500 HP. Allis Ch. Slipring 3/60/2200/514 RPM.
1—500 HP. Gen. Elect. Type I Form K. 3/25/440/488 RPM.
1—600 HP. West. Motor Type CS, 3/25/550/490 RPM.
1—600 HP. Gen. Elect. Slipring Type MT, 3/25/550/490 RPM.

VARIABLE SPEED MOTORS

2—300/150 HP. General Electric Motors Type BTA.—3 Phase 60 cycle 440 volts 360/280 RPM with controls.

3 PHASE 550 VOLTS 25 CYCLE MOTORS

Write for our stock list of approximately 500—3/25/550 Voltmotors

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y.
CL. 4758

POWER EQUIPMENT

INSPECTION INVITED

IMMEDIATE DELIVERY

DIESEL ENGINES

General Motos 900 HP Model 12-567, 2 cy. 12 cyl. 744 RPM with Falk reversing and reduction gear, ratio 2½ to 1. Electric starting. Auxiliaries available.

DIESEL GENERATORS

100 KW DC 240/120 V., 417 Amps., 1200 RPM. Motor: Superior, 150 HP Model GDB-8, 8 cyl., Electric Starting. Auxiliaries Available.

TURBO-GENERATORS

132 KW. AC, GENERAL ELECTRIC, Generator: 450 & 220 V, 3 Phase, 60 cycle, 1200 RPM. 275 Amps. Exciter: 40 KW. DC. 120 V. 22.6 Amps. Reduction Gear: 10071 to 1200 RPM. Turbine: 172 KW. Condensers available.

60 KW. DC. WESTINGHOUSE, Generator: 120 V. 1800 RPM. 500 Amps. Reduction Gear: 7283 to 1800 RPM. Turbine: 60 KW. 89.4 H.P. Condenser available.

NUMEROUS OTHER ITEMS ARE AVAILABLE FOR INDUSTRIAL USE.

FOR COMPLETE INFORMATION
WRITE PHONE

NORTHERN METAL CO.

MILNOR & BLEIGH STS. —SHIPBREAKERS— PHILA. 35, PA.

PHONE: MAfair 4-1400

POWER PLANT EQUIPMENT

Special Offerings

TURBO-GENERATORS

1—3500 KW 2300 V Cond.
1—2500 KW 600 V Cond.
1—2500 KW 2300 V Cond.
1—3000 KW 600 V Cond.
1—2000 KW 600 V Cond.
1—1500 KW 2300 V Cond.
2—1250 KW 2300 V Cond.
1—1000 KW 2300 V Non-C.
2—1000 KW 440 V Cond.
1— 625 KW 2300 V Cond.
1— 600 KW 240 V Cond.
1— 500 KW 600 V Cond.
1— 500 KW 2300 V Cond.
1— 500 KW 480 V Extrac.
1— 250 KW 2300 V Non-C.
1— 250 KW 240 V Non-C.

TURBO-GENERATORS (Continued)

1— 150 KW 2300 V Non-C.
1— 125 KW 600 V Extrac.
2— 125 KW 220 V Non-C.
1— 100 KW 600 V Non-C.
1— 50 KW 220 V Non-C.
1— 250 HP Turbine Gears
1— 375 HP Turbine Gears

ENGINE GENERATORS

2—400 KW 250 V. DC Vert. Uni.
1—375 KW 2300 V. Uniflow
1—168 KW 600 V.
1—168 KW 240 V.
1—168 KW 220 V. Uniflow
2— 96 KW 220 V. Uniflow

BOILERS

2—30,000# 425#
1—1030 HP 225#
1— 500 HP 400#
1— 300 HP 200#
1— 220 HP 160#
1— 200 HP 175#
6— 200 HP Sterling 160#
2— 190 HP 160# NEW
2— 510 HP Sterling 160#

AIR COMPRESSORS

1—6000 CFM 50# Motor
2—5600 CFM 50# Motor
1—4500 CFM 100# Motor
1—1300 CFM 100# Motor
1—6000 CFM 5.1# NEW
1—5000 CFM 10# Rotary Type Motor

Write or wire for additional data and prints.

A. LEE ELLIS CO., U. S. Machy. Bldg., 140 Federal St., Boston 10, Mass.

The Buyers Must Be Satisfied—Always

AVAILABLE
FOR IMMEDIATE DELIVERY

DESIRABLE

POWER PLANT EQUIPMENT

TURBO-GENERATORS

1—6000 KVA Westinghouse 2400 V surf. cond.
1—3750 KVA G.E. 480 V. cond.
1—2500 KVA Allis-Chalmers 2300 V cond.
1—1250 KVA G.E. 480 V mixed pressure

ENGINE GENERATORS

2—875 KVA Skinner Uniflow—direct connected to Westinghouse 240/480 V gen.
1—875 KVA Allis-Chalmers full releasing Corliss 480 V
1—375 KVA Ames vertical 220/440 V
1—275 KVA Ridgeway N.R.C. 2300 V
1—187 KVA Ames vertical
1—156 KVA Ames vertical 240 V

DIESEL ENGINES

1—250 KVA G.M. 220/440 V 3 phase 60 cycle "twin" 6-71 diesel engine generating unit. New—not War Surplus.
1— 75 KVA Buda 240 V 3 phase 60 cycle generating unit. New—not War Surplus.
Also General Motors, Fulton, Fairbanks and Nordberg engines from 15 to 1000 KW.

ELECTRICAL EQUIPMENT

Large stock of Transformers, Motors, M.G. Sets, and Generators

WIRE—PHONE—WRITE
For Complete Specifications

LARGEST STOCK OF MODERN POWER PLANT EQUIPMENT ON THE PACIFIC COAST

BEESON ENGINEERING CO.

1628 E. 7th St., Los Angeles 21, Cal.
Mutual 9151

ASME BOILERS Nat'l Bd.

2—104 HP sectional steel header cross drum Springfield, 10' settings, oil fired.
2—25,000# (normal rating) Stirling's pulverizers, 125#.
2—400 HP sectional header, underfeed stokers.
1—300 12' settings, 7 years old, stack & breeching for these 3 units.

H. P. BREARLEY
3423-91st Street Jackson Heights, N. Y.

STEEL STORAGE TANKS

6—74,000 & 35,000 Bbl. Vertical
8—25,000 Gal. Cap. Horizontal
6—10,000 & 3—20,000 Gal. Horizontal

DARIEN CORP.
60 E. 42nd Street, New York, N. Y.

STOP!

NO NEED TO LOOK FURTHER FOR THE BEST IN GOOD USED AND NEW POWER EQUIPMENT—

CHECK LIST FOR YOUR NEEDS NOW

Underwood & Underwood

BOILERS—PORTABLE—FIRETUBE
1—61 HP Kewanee, 100#
1—72 HP Fitzgibbons, 100#
2—80 HP Erie City, 125#
1—85 HP Kewanee, 100#
2—89 HP Kewanee, 100#
1—102 HP Ames, 125#
1—106 HP Keeler, 125#
1—109 HP Titusville, 125#
1—125 HP Bigelow, 125#
1—125 HP Titusville, 125#

BOILERS—SCOTCH—FIRETUBE
1—20 HP Leffel, 125#
1—40 HP Leffel, 125#
1—60 HP Leffel, 125#
1—75 HP Leffel, 125#
1—150 HP Murray, 150#
2—160 HP Marines, 125#

BOILERS—HRT—FIRETUBE
1—200 HP Keeler, 150#
1—300 HP Leslie & Elliott, 130#

BOILERS—WATERTUBE—BOX HDR.
1—48 HP International, 125#
1—165 HP Keeler, 200#
2—170 HP Casey Hedges, 170#
3—200 HP Heine, 160#
1—250 HP Casey Hedges, 160#
1—298 HP Keeler, 200#
2—300 HP Oil City, 160#
2—309 HP Casey Hedges, 165#
4—400 HP Heine, 225#
2—406 HP Heine, 180#
2—508 HP Casey Hedges, 190#
1—650 HP Heine, 225#

BOILERS—WATERTUBE—SEC. HDR.
1—200 HP B&W, 200#
2—400 HP B&W, 200#
2—404 HP Springfield, 160#
4—440 HP B&W, 200#
2—480 HP Springfield, 250#
3—500 HP Walsh-Weidner, 175#
2—600 HP B&W, 350#

BOILERS—WATERTUBE—BENT TUBE
1—100 HP Union, 125#
1—112 HP Collins, 150#
2—190 HP Vogt, 160#
2—220 HP Vogt, 160#
1—225 HP B&W, 170#
1—New 15,000# /hr. Bros, 100#
3—400 HP B&W, 200#
1—New 20,000# /hr. Bros, 250#
1—New 25,000#/hr. Bros, 250#
1—50,000# /hr B&W, 400#
1—750 HP Union, 250#
3—850 HP B&W, 200#

TURBO-GENERATORS—DC
3—25 KW Westinghouse, 125 V. Non. Cond.
1—25 KW DeLaval C.-W, 125 V. Cond.
2—60 KW Westinghouse, 120/240 V. Cond.
1—100 KW Westinghouse, 125 V. Cond.
1—150 KW Terry-GE, 125 V. Cond.
1—150 KW Moore-Westinghouse, 120 V. Cond.
1—200 KW GE, 120 V. Cond.
1—200 KW GE, 230 V. Cond.
1—300 KW Westinghouse, 120 V. Cond.
1—500 KW Westinghouse, 125/250 V. Non-Cond.

TURBO-GENERATORS—AC
2—50 KW G.E., 450 V. Non-Cond.
1—75 KW G.E., 480 V. Non-Cond.
1—100 KW Westinghouse, 240 V. Non-Cond.
1—132 KW Westinghouse, 450 V. Cond.
1—150 KW Allis Chalmers, 480 V. Cond.
1—200 KW Westinghouse, 450 V. Cond.
1—200 KW Westinghouse, 240 V. Non-Cond.
4—250 KW G.E., 250/440 V. Cond.
1—300 KW Moore-AL C., 2300 V. Cond.
1—500 KW Kerr-A.-C., 600 V. Cond.
1—500 KW G.E., 2300 V. Cond.
1—500 KW G.E., 2400 V. Non-Cond.
1—500 KW G.E., 2300 V. Non-Cond.
1—500 KW G.E., 240 V. Cond.
1—600 KW G.E., 2300 V. Cond.
1—625 KW Westinghouse, 2400 V. Non-Cond.
1—750 KW G.E., 2300 V. Cond.
1—750 KW G.E., 240 V. Cond.
1—750 KW Ford, 2300 V. Cond.
1—1000 KW DeLaval, 4150 V. Non-Cond.
1—1000 KW Westinghouse, 2400 V. Cond.
1—1000 KW G.E., 480 V. Non-Cond.
1—1000 KW G.E., 600 V. Cond.
1—1000 KW Allis Chalmers, 2300 V. Cond.
1—1000 KW Allis Chalmers, 480 V. Cond.
2—1000 KW Elliott, 480 V. Cond.
1—1250 KW Allis Chalmers, 2300 V. Cond.
1—1250 KW Westinghouse, 480 V. Cond.
1—1250 KW G.E., 230C V. Cond.
1—1500 KW G.E., 440 V. Non-Cond.
1—2000 KW G.E., 2300 V. Cond.
1—2500 KW G.E., 2300/4160 V. Cond.
1—2500 KW G.E., 2300 V. Cond.

• PUT ALL IDLE EQUIPMENT TO WORK, SEND YOUR LIST FOR PROMPT ACTION.

J. PARKER THOMPSON COMPANY, Inc.

507 FIFTH AVENUE, NEW YORK 17, N. Y.

Phones MURRAY HILL 7-6547-8-9

CABLE ADDRESS: "PARKTOM" NEW YORK

FOR SALE

GEAR TRANSMISSION

300 HP Sturtevant
2515 to 900 RPM Design #3

ELECTRIC APPARATUS REPAIR CO.
1400 No. 6th St., Phila. 22, Pa.

TRANSFORMERS

1 KVA up to 200 KVA in stock

ARROW TRANSFORMER CO., INC.
1932 E. Westmoreland St. Phila. 34, Pa
Phone Ga. 5-0488

COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

"Export Orders Carefully Executed"

BOILER UNITS
1—140,000# New Steam Generator 600#
1—140,000# MODERN Steam Generator 450#
2—60,000# MODERN Boilers 450#
2—30,000# MODERN Steam Generators 450#
2—1040 HP Heine Boilers—Super 200#
2— 825 HP B&W Co. Stirling—Super 200#
2— 600 HP B&W Co. Sectional—Super 200 to 350#
3— 310 HP B&W Co. Stirling 180#
Also smaller Boilers & Fire Tube Boilers

TURBO UNITS
3—5,000 KW Turbo-Generators—Cond.
1—4,000 KW same as above
2—2,500 KW same as above
3—2,000 KW same as above
2—1,500 KW same as above
2—1,250 KW same as above
2—1,000 KW same as above
1— 500 KW same—Also 750 KW & 300 KW Units
Non-Cond:—300 - 500 - 750 - 1000 - 1500 - 2000 - 2700 KW.

COMPLETE STEAM PLANTS: One with 2-1500 KVA's, One of 2500 KVA & One of 7500 KVA.
Frequency Changers—Transformers! Send us your requirements—We may have it.
Send us your INQUIRIES *for* ALL POWER MACHINERY

CHARLES B. REARICK **30 CHURCH ST.** **NEW YORK 7, N. Y.**

KIEMLE OFFERS

Rebuilt and Sold with a Standard New Guarantee

IND. FREQUENCY CHANGER SETS

MOTOR GENERATOR SETS
ALTERNATORS, ALL FREQUENCIES
TRANSFORMERS, LARGE STOCK
D. C. GENERATORS, ALL VOLTAGES
CONTROL EQUIPMENT

ALL SIZES
VOLTAGE AND CYCLES

3 ph. 60 cy. A.C. Motors
3 ph. 25 cy. Motors
125 Volts D. C. Motors
230 Volts D. C. Motors
550 Volts D. C. Motors

THE FRED W. KIEMLE CO., 33 N. SUPERIOR ST., TOLEDO 4, OHIO

Put all idle equipment to work. Send your list for prompt action. **WRITE OR WIRE YOUR INQUIRIES**

TURBO GENERATORS

TURBINE OF THE MONTH

1—780 KVA Westinghouse 3600 RPM 125/150 lbs. I.S.P., 2/10 lbs. G.B.P., Non-condensing 3 ph., 60 cycle, 2400 v. direct connected exciter.
Can Rebuild for 400 lbs. 700° F.

1—2000 KW G.E. 6600v, 3 ph., 60 cy. with 175 lb. cond. turbine and dir. conn. exciter.

1—1500 KW Westg. 400#, 700°F, condensing 3 ph, 60 cy. 2400 V. Surface condenser.

1—450 KW Whse 250 lbs. I.S.P. Surface Condensers—Auxiliaries—3 phase, 60 Cycle, 400 Volts. Direct connected Exciter Equipment built 1944.

2—1250 KW G.E. 2300v, 3 ph. 60 cy. with 175 lbs. condensing turbine

1—1250 KW Al Ch. 2300v, 3 ph. 60 cy. with 200 lb. condensing turbine surface condenser.

1—1000 KW G.E. 2300/4150v, 3 ph., 60 cy. with 135/150 lb. condensing turbine.

1—500 KW G.E. 480v, 3 ph., 60 cy. dir. conn. exciter with 80/100 lbs. I.S.P. 10 15 lbs. B.P., non-condensing turbine.

2—500 KW G.E. 2400 v, 3 ph., 60 cy. dir. conn. exciter, 175 lbs. I.S.P. 10/15 lbs. B.P. non-cond.

BELYEA COMPANY INC.

43 HOWELL ST. **JERSEY CITY 6, N. J.**

Phone—Journal Square 2-3334
ALSO N. Y. CITY LINE—RECTOR 2-7150

HEADQUARTERS for GEARMOTORS

Brand New G.E. and U.S. 3 Phase 60 Cycle 220/440 Gearmotors in Stock
Guaranteed for One Year

8 —	½ HP	84 rpm
13 —	⅓ HP	190 rpm
3 —	¾ HP	20 rpm
10 —	¾ HP	190 rpm
5 —	1 HP	37 rpm
7 —	1 HP	100 rpm
3 —	1 HP	190 rpm
10 —	1 HP	280 rpm
2 —	2 HP	16.5 rpm
4 —	2 HP	37 rpm
10 —	2 HP	190 rpm
2 —	2 HP	230 rpm
9 —	3 HP	45 rpm
3 —	3 HP	190 rpm
3 —	3 HP	350 rpm
2 —	5 HP	155 rpm
8 —	5 HP	230 rpm
6 —	7½ HP	13.5 rpm
6 —	7½ HP	420 rpm
1 —	10 HP	100 rpm
3 —	10 HP	125 rpm
3 —	15 HP	350 rpm
1 —	20 HP	100 rpm
1 —	60 HP	56 rpm

ABOVE MOTORS IN STOCK

Can ship unlisted gearmotors 1 to 25 HP in 2 to 4 weeks, practically all ratings. Also, good stock of rebuilt gearmotors from ½ HP to 40 HP

Prompt Detailed Replies to All Inquiries

SANDMAN ELECTRIC CO., Inc.
NEW ENGLAND'S LEADING MOTOR DEALER
166 Oliver St. **Boston 10, Mass.**

TRANSFORMERS

60 CYCLE—1 PHASE

3—25 KVA Niagara O.I.S.C. 2400/4160Y-120/240.
3—25 KVA Niagara O.I.S.C. 2400/4160Y-240/480.
3—37½ KVA Niagara O.I.S.C. 2400/4160Y-120/240.
3—37½ KVA Niagara O.I.S.C. 2400/4160Y-240/480.
3—50 KVA Niagara O.I.S.C. 2400/4160Y-120/240.
3—50 KVA Niagara O.I.S.C. 2400/4160Y-240/480.
3—75 KVA Niagara O.I.S.C. 2400/4160Y-120/240.
3—75 KVA Niagara O.I.S.C. 2400/4160Y-240/480.
3—100 KVA Niagara O.I.S.C. 2400/4160Y-120/240.
3—100 KVA Niagara O.I.S.C. 2400/4160Y-240/480.
3—150 KVA Niagara O.I.S.C. 2400/4160Y-240/480.
3—200 KVA Niagara O.I.S.C. 2400/4160Y-240/480.
3—250 KVA Niagara O.I.S.C. 2400/4160Y-240/480.
3—333 KVA Niagara O.I.S.C. 2400/4160Y-240/480.

All transformers listed for March Stock Shipment—Short delivery on sizes from 25 KVA to 5000 KVA, 1 or 3 phase in voltage ratings to 40 KV.

Write, Wire or Phone

ERIE ELECTRIC CO., INC.
124 CHURCH ST. **Phone: CL. 4758** **BUFFALO 2, N. Y.**

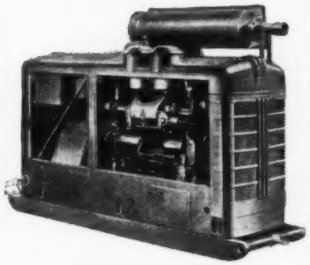
FOR SALE

COMPLETE 2500 KW STEAM POWER PLANT

consisting of two, 1250 KW 3-phase 60-cycle, 2300-volt, Allis-Chalmers turbo-generators with control panels, condenser, boilers, economizers, super-heaters, feed water regulators, pumps, piping, induced-draft fan, direct firing coal pulverizers with bin and stand-by fuel oil burning equipment. All equipment complete with motors and controls where required. In excellent condition and now available.

CONSOLIDATED CEMENT CORP.
111 W. Monroe St. **Chicago 3, Ill.**

NEW
60 KW GMC DIESEL SETS
for
IMMEDIATE DELIVERY



These fully-portable, self-contained units are offered at considerably less than manufacturer's list prices.

WRITE OR WIRE TODAY
FOR COMPLETE INFORMATION

OTHER NEW UNITS AVAILABLE
FROM 10 KW TO 50 KW

A. G. SCHOONMAKER CO., INC.
52 Church St., New York 7, N. Y.

MODERN DIESEL GENERATING PLANTS

450 HP Fairbanks-Morse Diesel Engine, 6 cylinder, series 32-E-14, 300 RPM, direct connected to 300 KW Fairbanks-Morse generator, 240 volt, 3 phase, 60 cycle.

300 HP Fairbanks-Morse Diesel Engine, 4 cylinder, series 32-E-14, 300 RPM, direct connected to 200 KW Fairbanks-Morse generator, 240 volt, 3 phase, 60 cycle.

30 KW Ready-Power Portable generator sets.

DENNY & CLARK
1923 W. North Ave., Chicago 22, Ill.

"Hp" FOR MODERN EQUIPMENT

STEEL STORAGE BINS—HOPPER TYPE—1—66' long, 16' wide, 10'-6" high straight side, 6'-6" height of hopper, 6 compartments.

1—11' long, 8'-9" wide, 10" high straight side, 6'-6" height of hopper, 2 compartments.

1—88' long, 12' wide, 7' high straight side, 6' height of hopper, 8 compartments.

3—34' long, 12' wide, 6'-6" high straight side, 9' height of hopper, 4 compartments.

1—22' long, 11'-6" wide, 7'-3" high straight side, 6'-3" height of hopper, 4 compartments.

STACKS—3—5'-3" dia. x 110', 3/8' and 5/16" plate with reinforcing bands every 10'-8".

AIR COMPRESSORS—8—C.P. 12" x 10" NSB, 266 CFM, 100# pressure.

GAS PURIFICATION SYSTEM—Complete with tanks, valves, piping; capacity 2,000 to 16,000 cu. ft. per hour.

PUMP—Frederick Iron & Steel Co. 8" DSV-SM, 2,500 GPM, 150' H., nickel iron casing, stainless steel trim, comp. with 125 HP, TEFC Motor and Control Panel.

BOILER PLANT—Complete plant, Erie City, 604 HP, 180 PSI, ASME code and Natl. Board. Pulverized coal fired.

DIESEL GENERATOR SETS—3—G. M. Model 6-71RC, 1200 RPM, 6 cylinders, direct connected to 75 KVA Generators 3/60/127-220, complete. New 1945. Only used 100 Hours. Guaranteed condition.

3—G. M. Model 8-268A, 1200 RPM, 8 cyl., direct connected to 300KW D.C. Generators 120/240, comp. New 1942-3.

5—Superior Model GDB-8, 1200 RPM, 8 cyl., direct connected to 100KW D.C. Generators 120/240, comp. New 1942-3.

AIR CONDITIONING UNITS—2—NEW CHRYSLER AIRTEMP units 75 ton complete with Trane Evaporative Condensers, Fans and Motors.

1—20 ton, Frigidaire

TRANSFORMERS—10 KVA G. E. 2400-240/480.
25 KVA West. 450-117 air cooled (10).
37½ KVA G.E. 4600-2300 (3 avail.).
100 KVA West. 4160-208/120, 3 phase.
200 KVA G. E. Pyranol 2400-4160Y/240-120.
200 KVA G. E. Pyranol 2400-4160Y/240-480.
500 KVA West. 4160-480.

CONVEYORS—BELT—Barber Greene complete loading conveyor, 24", 18' troughing type with rails and drive.

1—24" Flat, 30' centers and drive.

ELEVATORS—BUCKET—48' centers, single 825 strand chain, 14"x7" MI Buckets, steel encased.

68' centers, single 825 chain, 10"x6", MI Buckets, steel encased.

Heat and Power Co., inc.
70 PINE STREET Hp DIGBY 8-0373 Hp **NEW YORK 5, N. Y.**

CENTRIFUGAL PUMPS
Split Case Double Suction
Cast Iron bronze fitted.

2—14"x12" Dayton Dowd, Type CSLH, Capacity 6000 GPM, 110' HD 1750 RPS Ser. No. 33199. 200 HP

1—12"x10" Dayton Dowd Type CSLH 3000 GPM 113' HD 1750 RPM. Ser. No. 31454

1—6"x5" Dayton Dowd, 1000 GPM, 231' HD, 100 HP Motor.

1—6"x5" Allis Chalmers Type S—1000 GPM 220' Hd 100 HD. 1750 RPM. All Bronze Multi Stage

1—5"x4" Gould 500 GPM 1320' Hd. 4 Stage Fig. 3360 250 HP 3450 RPM

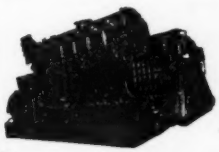
3—4"x4" Gould Fig. 3380, 250 GPM, 650' HD 80 HP 3450 RPM

1—2½"x2" Dayton Dowd 4 stage 80 GPM 1050' HD 50 HP 3450 RPM

We carry in stock a complete line of new and rebuilt pumps from ½" to 16". All pumps sold on a rebuilt and guaranteed basis as to condition and performance.

WE SOLICIT YOUR INQUIRIES.

C & S MACHINERY COMPANY
715 Howard St. St. Louis 6, Mo.



DIESEL
Generator Plants
For Immediate Delivery

HEMCO

1000 KW, 2400 Volts, 3 Phase, 60 Cycle, 720 RPM, General Motors Model 16-278A.
750 KW, 2400 Volts, 3 Phase, 60 Cycle, 720 RPM, General Motors Model 12-567.
600 KW, 2400 Volts, 3 Phase, 50 Cycle, 600 RPM, General Motors Model 12-567.
300 KW, 450/2400 Volts, 3 Phase, 60 Cycle, 1200 RPM, General Motors Model 8-268A.
200 KW, 450/2400 Volts, 3 Phase, 60 Cycle, 1200 RPM, General Motors Model 8-268A.
50 KW, 440 Volts, 3 Phase, 60 Cycle, 900 RPM, Fairbanks-Morse Model 36A 5½.
100 KW, 3 Wire, 125/250 Volts DC, 1200 RPM, General Motors Model 3-268A.
900 HP, General Motors Model 12-567, Propulsion Unit Complete.

HERCULES ELECTRIC MACHINERY and EQUIPMENT CO.

Tel. NEvada 6-2808 **1412-18 So. Alameda Street**
Cable Address HEMCOY **Compton, Calif.**

BERGER OFFERS

Rebuilt and Sold with a Standard New Guarantee

IND. FREQUENCY CHANGERS SETS

MOTOR GENERATOR SETS
ALTERNATORS ALL FREQUENCIES
TRANSFORMERS LARGE STOCK
D. C. GENERATORS ALL VOLTAGES
CONTROL EQUIPMENT

ALL SIZES, VOLTAGE AND CYCLES

3 ph. 60 cy. A. C. Motors
3 ph. 25 cy. Motors
125 Volts D. C. Motors
230 Volt D. C. Motors
550 Volt D. C. Motors

WRITE OR WIRE YOUR INQUIRIES

BERGER BROTHERS Electric Motors, Inc., 395 STATE ST., ROCHESTER 4, NEW YORK

PUT ALL IDLE EQUIPMENT TO WORK. SEND YOUR LIST FOR PROMPT ACTION.

TRANSFORMERS

FOR SALE

2—150 KVA. 60 CY. 1 PH. 2400-240/480 SCOTT TAPS.
6—100 KVA. 60 CY. 1 PH. 2400-240/120.
6— 75 KVA. 60 CY. 1 PH. 2400-240/120.
9— 50 KVA. 60 CY. 1 PH. 2400-240/120.
7—37½ KVA. 60 CY. 1 PH. 2400-240/120.
8— 15 KVA. 60 CY. 1 PH. 2400-480/240.

ALSO ALL TYPES OF AIR COOLED AND PHASE CHANGERS.

ATLANTIC TRANSFORMER CO.

5143 N. 2nd St. Philadelphia 20, Pa.

WURTH for "WORTH"!

A. C. GENERATORS 3 PHASE—1 PHASE 15 to 62½ KVA

LARGEST STOCK OF A.C. AND D.C. MOTORS FROM 5 TO 200 H.P.
D. C. MOTOR GENERATOR SETS TO 75 KW • HIGH CYCLE GENERATORS

Send for Our Latest Stock List

WURTH ELECTRIC MOTOR COMPANY

Motors, Generators, Alternators, Frequency Changers.

141 GRAND ST. — CAnal 6-6138 — NEW YORK CITY

FOR SALE

BOILERS
and
MACHINERY

2 Scotch Boilers—two furnace type, 12' x 14', 180 lbs. steam pressure
Feed Water Heater
Circulating Engine—size 6 x 6, ℄77890, built by Morris Machine Works
*Steering Engine, ℄1227
*Capstan, ℄1228
†Boiler Feed Pump
Size 9 x 6 x 12, ℄15572
†Fire Pump
Size 14 x 10 x 12, ℄15574
†Air Pump
Size 7 x 14 x 10, ℄15625
†Water Service Pump
Size 6 x 5¼ x 6, ℄15573
*Built by Bethlehem Shipbuilding Co.
†Built by Warren Steam Pump Co.

Address WJM,
Rm 1702, 122 E. 42 St., N.Y.C.

TRANSFORMERS

3—150 KVA, 2400 volts primary to 230/460 volts secondary, 60 cycle, 1-phase, Moloney, *new*.
3—150 KVA, 13,800 volts primary to 130/260 volts secondary, 60 cycle, 1-phase, Wagner late model, steel case.
3—667 KVA, 13,800 volts primary to 230/460 volts secondary, 60 cycle, 1-phase, Wagner late model, steel case.
1—100 KVA, 33,000 volts primary to 2300/4160 volts secondary, 60 cycle, 1-phase, General Electric, type "H", Form K.D., steel case.
1—37½ KVA, 4000 volts primary to 115/230 volts secondary, 60 cycle, 1-phase, General Electric, type "H", Form K, steel case.
1—10 KVA, 6,600 volts primary to 110/220 volts secondary, 60 cycle, 3-phase, Moloney, Type "T", C.I. case.
1—100 KVA, 6900 volts primary to 115/230 volts secondary, 60 cycle, 1-phase, General Electric, Type "H", Form KR, steel case.

All in Stock for Prompt Shipment. Will Be Overhauled and Guaranteed.

INDEPENDENT ELECTRIC MACHINERY COMPANY

300 Southwest Boulevard **Kansas City, Missouri**

INGERSOLL-RAND DIESELS
SKINNER UNIFLOW ENGINES

For generating, pumping or compressors

1—385 HP type S diesel, 600 RPM 10½" bore 12" stroke, coupled to G. E. 250 KW 125/250V D. C. generator.

1—255 HP type S diesel, 600 RPM 10½" bore 12" stroke, coupled to G. E. 150 KW 125/250V D. C. generator.

2-400 HP Uniflows, 200 RPM 22" bore 24" stroke, coupled to G. E. 250 KW 125/250V D. C. generators.

All standing in New York City plant.

FS-8021, POWER

330 W. 42nd St., New York 18, N. Y.

FOR SALE

2—Used 300 H.P. Boilers complete with steel stack, breeching, stokers, feed water pump and heater. Immediate delivery F.O.B. cars on acceptable bid.

MIDWEST MFG. COMPANY

Galesburg, Illinois

TURBO GENERATORS
FOR SALE

6000 KVA Condensing, 2400 v. 225 lbs. Complete
1250 KVA Condensing, 2300 v. 200/300 lbs. Also others.

STEPHEN A. DOUGLASS CO.
630 Fort Washington Ave., New York 33, N. Y.

SEARCHLIGHT SECTION

SLIP RING MOTORS

3-Ph., 60 Cy.

HP	Volts	Make	Speed
450	440/220	Whse.	514
300	440/220	G.E. MTC	600
200	440/220	G.E.	900
200	2200/440	G.E.	600
200	2200/440	G.E.	1200
200	440	G.E.	450
150	440/220	Whse. (2)	1800
150	2200/440	G.E.	1200
150	440/220	G.E.	720
125	2200/440	G.E.	600
100 (2)	440/220	Whse.	900
100	2200/550	G.E.	1800
50	440/220	G.E. (MTC)	900
75	2200/550	G.E.	1800
75	440/220	Whse. 25 cy.	750

SYNCHRONOUS MOTORS

3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/220	G.E.	ATI	600
300	440/220	G.E.	ATI	600
250	440/220	Whse.	HP	277
250	440/220	G.E.	ATI	600
240	440/220	Whse.	G	1800
200	4150/2360	Whse.	G	1800
120	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	Whse.	G	1800
75	2200/440	Whse.	GE	600

GENERATOR SETS

1—62½ kva. 1200 rpm. 220 volt, Whse., geared to 7300 rpm. Whse., non-rated, steam turbine. 150 lbs. pr.
2—unused 25 kva. 120/208 v., 3 ph., 1200 rpm. generator dir. conn. to Waukesha 6 cyl. gas engine.

AIR COMPRESSOR UNIT

1—13" and 8" by 10" Worthington FEATHER-VALVE. 285 rpm. 110 lbs. ga. motor-driven.

CIRCUIT BREAKERS

2—2000 amp., GG E, 3 pole, 600 v., air
2—1600 amp., ITE, 3 pole, 600 v., air
2—1200 ampere, Whse, 3 pole, 600 v., air

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	900
400	550	G.E.	IK	720
300	2200/550	Whse.	CS	1800
200	440	G.E.	IK	514
200	440/220	Whse.	CS	1200
200	440/220	G.E.	KT	1800
200	2200/440	G.E.	KF	720
200	2200/550	Cr. Wh.	8C	900
200	2200/440	G.E.	KT	1200
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Brg.	1800
150 vert.	440/220	G.E.	KTP	1200
125 vert.	440/220	G.E.	KTP	1200
100	550	Cr. Wh.	Q	900
100	2200/440	G.E.	K	1200
60	440/220 (new)	I. Allis	OGA	1800

A. C. GENERATORS

1—320 kva., 600 rpm., 440/220 v., G.E.
1—225 kva., 600 rpm., 220/440 v., G.E.
1—150 kva., 1800 rpm., 2200/550 v., Whse.
1—112 kva., 900 rpm., 440/220 v., G.E.
1— 98 kva., 1800 rpm., 440/220 v., G.E.
2— 75 kva., 1800 rpm., 440/220 v., Whse.

D. C. MOTORS

HP	Volts	Make	Type	Speed
200	230	Cr. Wh.	CMC	800
150	230 (new)	Cr. Wh.	TEFC	900
100	230	Cr. Wh.	CMC	625
100	230	G.E.	CD	1750
75	230 (new)	Whse.	SK	1150
75	230	Whse.	SK	850
75	230	Whse.	SK	1750

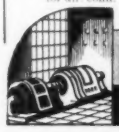
MOTOR GENERATOR SETS

1—165 kw, 1200 rpm, 240 v., G.E., conn. to 250 hp, 1200 rpm, 440/220 v., squirrel cage.
1—150 kw, 900 rpm, 240 v., Cr. Wh., conn. to 225 hp, 900 rpm, 2200/550 v., squirrel cage.
1—125 kw, 1200 rpm, 250/120 v., G.E., conn. to 175 hp, 1200 rpm, 4000/2300/440 v., synchronous.
1—75 kw., 125 v., 1200 rpm., G.E. conn. to 120 hp., 2200/440 v., syn. motor.
1—50 kw., 250/1200 rpm., G.E. conn. to 75 hp., 440/220 v., 60 cy., G.E. syn. motor.
1—50 kw., 250/1200 rpm., G.E. conn. to 75 hp., 440/220 v., 60 cy., syn. motor.

TRANSFORMERS

60 Cy.

1—1000 kva., Al. Chal. 2400-120/240/208 volts, 3 ph.
1— 400 kva., G.E. 2300-230/115 v.
3— 300 kva., G.E., 13800/6900-115/230/460 v.
3— 200 kva., Moloney, 2400-240/480 v.
2— 150 kva., G.E., 13800/6900-110/220 v.
1— 150 kva., Whse. SK, 13200-125/215 v., 3 ph.
6— 100 kva., G.E., 4600/2300-230/115. NEW
3— 100 kva., G.E., 440-115/230 v., dry, 1 ph., new
5— 75 kva., G.E., 2400-240/120 v.
3— 75 kva., G.E., H-Sf., 2300-230/460 v.



STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

MOTORS GENERATORS

540 KW Whse Turbo-Gen 240 v d-c, 200 lbs. non-cond., new 1944
2—90 HP 575 RPM 230 v d-c Whse SK Marine motors w. starters
400 HP 900 RPM 3/60/440 G-E S1 Rg I-M
350 HP 720 RPM 3/60/440 Whse S1 Rg CW
200 HP 1800 RPM 3/60/440 Wagner Sq C
2—200 HP 900 RPM 3/60/550 Whse S1 Rg CW
200 HP 600 RPM 3/60/2200 A-C S- Rg
2—150 HP 514 RPM 3/60/550 (or 440) West Elec S1 Rg
125 HP 3600 RPM 3/60/2200 Elliott Sq C
125 HP 3600 RPM 3/60/440 Elliott Sq C
2—125 HP 900 RPM 3/60/440 Wagner Sq C
6—333 KVA 13,200-460/230 Wagner 12 ROC trans 1 ph., 60 cy. OISC
3—100 KVA 2400-240/480 G-E trans 1 ph, 60 cy. OISC

C & S MACHINERY CO.
715 Howard St. St. Louis 6, Mo.

FOR SALE

125 HP 150# WP Code Locomotive Boiler
10'x5'/16" D&K Power Shear—10 use
400 KVA 220/440 V. Gen. D/C Engine
21 Ton S. Tank Locomotive oil-steam
20' (2) Dipping Tanks with Agitators
4" 200 GPM Centrifugal Pumps—NEW

H. & P. MACHINERY CO.
6719 Etzel Ave., St. Louis 14, Mo.

FOR SALE — DIESELS

1—300KW Fairbanks-Morse Generator Set
1—300KW Buckeye Diesel Generator Set
1—200KW Buckeye Diesel Generator Set
1—175KW Buckeye Diesel Generator Set
1—125KW Buckeye Diesel Generator Set
2—100KW Buckeye Diesel Generator Set
3—75KW Buckeye Diesel Generator Set
1—167KW F-M Generator Set
1—108KW F-M Generator Set

WRITE WIRE PHONE

ROBERT L. NEISWANDER
Phone 4-2867
Lima, Ohio P. O. Box 554

DIESELS

Two (2)—900 H.P. at 700 RPM. Mfr.—Maschinen Fabrik Augsburg—Nurnberg (M.A.N.) Complete with Auxiliary Equipment.

DIESEL-GENERATORS

Twelve (12)—12.5 KVA 230/400 volts — 50 cycle International Harvester—Marble Card.

One (1)—100 KW D.C. 230 Volt—423 Amp. at 900 RPM 230 Volt—350 Amp. at 750 RPM. M.A.N. Diesel—6 cylinder.

TURBO-GENERATORS

Four (4)—250 KW A.C. plus 40 KW D.C. 250/450 V 3 phase, 60 cycle or 200 KW plus 30 KW D.C. 220/380 V—50 cycle Mfg. by General Electric Co.

Two (2)—300 KW D.C. 120/240 volt 6 Pole—3 wire—Comp. Wound Turbine by Worthington Moore. Generator — Allis Chalmers.

Two (2)—300 KW D.C. 120/240 volts. Comp. Wound Turbine by J. Handy. Generator—Westinghouse.

This Equipment in Original Crates

INTERNATIONAL FERMONT MACHINERY CO., INC.

115 BROADWAY NEW YORK 6, N. Y.

MARCH OFFERINGS

1—B & W—Water Tube Boiler 200# P.S.I. A.S.M.E.—Natl. Board—400 H.P. —1923

2—Heine-Water Tube Boilers—225# P.S.I. Cross Drum—Steel Cased—3½" tubes—1924—Retubed 1943

1—Erie City—3 Drum Water Tube—1934 275# P.S.I.

Also New Package Units—30—300 HP—15#—100#—125#—150#

HOWE BROTHERS

342 MADISON AVENUE NEW YORK 17, N. Y.
Tel. Nos. MU. 2-8562—8563—8564

IMMEDIATE SHIPMENT!

650 H. P. Casey Hedges Boiler 225 PSI
250 H. P. Casey Hedges Boiler 225 PSI
100 H. P. Locomotive Firebox Boiler 120 PSI
40 H.P. Leffel Scotch Marine Boiler 125 PSI

WIRE WRITE PHONE

SEE Fletcher FIRST!

FLETCHER SALES CO.
325 Fincastle Building LOUISVILLE, KY.

PARTIAL LIST — STOCK DELIVERY

1000 KVA West. Syn. Motor 600-3-60-900 RPM
270 KVA West. Gen. 600-3-60-164 RPM
125 HP GE Syn. 600-3-60-300 RPM
75 HP GE Syn. 2300-3-60-360 RPM
150 HP West. Syn. 2300-3-60-514 RPM
125 HP GE Sq. Cage 2300-3-60-1200
2—50 HP Ideal Sq. Cage 208-3-60-450/600/900/1200 RPM
4—50 HP GE Type K445S, 440-3-60-1775/875 RPM TEFC
2—50 HP New Century Frame 454S, 230 volt DC 2200
2—190/100 HP GE MPC 230 volt DC 300/100 RPM
125 KW GE M/G Set 125 volt DC 1200 RPM with 190 HP Syn. Motor
25 & 35 KW Steam Driven Turbo Units 125 and 250 V DC
500 KW GE Curtis Turbo-Generator Set 600-3-60-3600
200 & 300 Amp. Electric Motor Driven Portable Welders
78 HP Winton and 57 HP Ruston Hornsby Diesel Engines
8—1500 and 2000 Amp. GE Oil Circuit Breakers
1600 Amp. GE Type AL2 600-3-60 Air Breaker
3000 Amp. West. DA75 600-3-60 Air Breaker
6000 Amp. ITE Breaker 220-3-60
3—150 KVA Pitts. 22000V Pri. 575V sec. 1-60
150 KVA GE HT-F 4320Y V Pri. 125/217V sec. 1-60
3—200 KVA Pitts. 575V Pri. 115/230V sec. 1-60
3—333 KVA Pitts. 13800V Pri. 250/500V sec. 1-60

Largest stock in N.E. of new and used electrical equipment; special-gearmotors, reducers, variable speed, AC & DC.

Established 1900

A. WERBY & COMPANY
367-373 ATLANTIC AVENUE BOSTON 10, MASS.

FOR SALE
NEW UNUSED
POWER EQUIPMENT

1—400 HP Hydraulic coupling for adjustable speed fan drive with 400 HP, 2300 volt, 900 RPM, 3 phase, 60 cycle motor and starter.
2—1200 PSI Boiler Feed Pumps, six stage Worthington type 4-UX-2, 3570 RPM, 500 GPM. One without drive and one with 200 HP, 3 phase, 60 cycle motor and starter.
2—Chapman 6 inch List 901 Welding End, cast carbon chrome Molybdenum steel swing check valves with 18-8 stainless trim

ALSO

1—Used 35-ton Railroad Crane—steam type

CORNELL UNIVERSITY
Purchasing Dept.
ITHACA, NEW YORK

FOR SALE
Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.
PENN MACHINERY COMPANY
Jackson, Miss.

1—Allis-Chalmers 333KW AC Generator, 240 volts, 1000 amperes, 0.8 P. F. 60 cycle, 3 phase, 150 RPM, with shunt wound 20 K.W. excitor. Direct connected to Allis-Chalmers condensing horizontal cross-compound Corliss Engine, 22.6# steam/hr. at rating. High pressure cylinder 18" x 30"—150 RPM. Low pressure cylinder 32" x 30"—throttle pressure 140# gauge—operating to 26" Hg. vacuum, 13' dia. x 10" balance wheel. Nugent oiling system. Worthington Surface Condenser 770 sq. ft. Marsh Vacuum pump 8" x 12" x 12" Never Used Field Rheostat.

1—General Electric 140 KW AC Generator 240 volt, 421 amp. 0.8 P. F. with 9½ KW compound wound D.C. exciter 115 volt direct connected to non-condensing 18 x 18 Skinner Uniflow—center crank Engine 140 KW. 7' x 18" balance flywheel. 140# operating pressure. 5# back pressure. Field Rheostat.

Available for Inspection at

Fitzgibbons Boiler Company, Inc.
23 MERCER STREET OSWEGO, NEW YORK

FOR SALE

600 KW Turbo-Gen. Set GE, 3-60-2300, 3600 RPM, 4 stage Curtis 140-180 lb. Jet Condenser. M-G Exc. Set, all accessories and Panel. *Excellent cond. LOW PRICE.*

INDUSTRIAL TRADING CO.
30 Church St., New York 7, N. Y.

50,000 lb. Integral Furnace 400 lb. B & W boiler superheater air heater pulverizer fans accessories
2500 KW 2400 volt GE Cond. turbine unit.
1500 KW 480 volt GE NonCond Turbine set.
283 KVA 240 volt Chase Uniflow engine set.
200 KVA 480 volt Ridgway 4 valve engine set.
200 KW G. E. M. G. Set 2200 AC 250 DC.
50 KW G. E. M. G. Set 220/440 AC 250 DC.

HOWARD B. JOHNSON & ASSOCIATES
53 W. Jackson Blvd. Chicago 4, Ill.

Most all units still on foundation. Many may be seen operating

TURBO UNITS (Cond.)

1875 KVA (2) General Electric 2300 v.
1250 KVA (2) General Electric 2300/4150 v.
750 KVA General Electric 2300 v.
750 KVA General Electric 220/480 v.
625 KVA General Electric 2300 v.
375 KVA General Electric 2300 v.

TURBO-UNITS (Non-Cond.)

375 KVA (2) GE 2300/440/220 v.
250 KVA General Electric 600 v.
112.5 KVA General Electric 480/220 v.

DIESEL UNITS

156 KVA Ideal 240/480 v.—Buckeye
125 KVA GE 240/480 v.—Superior
93 KVA GE 480/240 v.—Superior
75 KVA GE 240/480 v.—General Motors
50 KVA FM 240/480 v.—Model 36-A

37 KVA (3) General Motors 240/480 v. (NEW)
Gas Unit—375 KVA GE 480 v.—Cooper Bessemer Gas

BOILERS

605 HP Union 3 drum 200#
507 HP Combustion 400#
488 HP Heine 250#
298 HP Keeler 200#
255 HP B&W 3 drum 170#
220 HP (2) Vogt 3 drum 160#
200 HP Erie City 3 drum 160#
110 HP Erie City 3 drum 180#
280 HP Combustion HRT 150#
106 HP Ames "Economic" 125#

STEAM ENGINE SETS, A.C.

1125 KVA GE-Nordberg Uniflow
625 KVA GE-Nordberg Uniflow

500 KVA GE-Erie Ball 4 valve
312 KVA GE-Chuse 4 valve
187 KVA Wghse.-Ames Unif. (vertical)
187 KVA GE-Chuse 4 valve

STEAM ENGINE SETS, D.C.

600 KW Wghse. 250 v.—Skinner Unif.
200 KW Wghse. 250 v.—Ames Unif. Vertical
200 KW GE 125 v.—Skinner Uniflow
150 KW GE 125 v.—Skinner Uniflow

PUMPS — MOTOR DRIVEN

COMPRESSORS — MOTOR DRIVEN

TRANSFORMERS

MOTOR GENERATOR SETS

POWER PLANT EQUIPMENT CO., INC.

39 Cortlandt St.
New York, N. Y.

SURPLUS ELECTRICAL EQUIPMENT

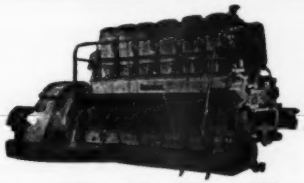
2—2100 HP, GE Synchronous motors, 514 RPM, 4600/2300 V., 3 phase, 60 cycle, 80% P.F. Complete with rheostats and belted exciters. Full details on application.
2—2000 KVA Transformers—Single phase 60 cycle, 69/34.5 KV to 4800/2400 V. Westinghouse O.I.S.C.
1—3500 KVA—3 phase, 60 cycle, 33/13.8 KV Westinghouse Transformer.
1—600 A., 3 P.S.T., 34.5 KV Outdoor O.C.B. Westinghouse CO-1-A.
1—3 pole, 600 A, 34.5 KV Outdoor Disconnect Switch.
Miscellaneous Distribution Transformers, Cable, Switches, Potheads and Electrical Instruments. Also Ross Carrier—hardly used. Arch measurements—91" high and 76" wide. 7 Ton capacity.

All the above are for immediate sale and are located at our Pulp Mill on Vancouver Island.

BLOEDEL, STEWART & WELCH, LTD.
904 Standard Building, Vancouver, B. C.

NEW ENTERPRISE DIESELS

450 HP
450 RPM
Model DSG-6



375 KVA
300 KW
AC STD VOLTAGES

Qu.	HP	Model	RPM	KVA	KW	GEN.	Ph.	Cycle	Volts
2	1600	General Motors 16-278A	720	1250	1250	General Elec	3	60	2300
2	1600	General Motors 16-278A	720	1250	1000	Elliott	3	60	2400/4160
*1	500	Fairbanks Morse Type Y	257	415	415	Fairbanks Morse	3	60	2400
**3	450	Enterprise DSG-6	450	. . .	250	Elliott	.	DC	120/240
1	300	Buckeye Model E	400	250	200	Elec. Mchnry.	3	60	240
**2	240/200	Buckeye	600/500	200/166	160/133	Ideal	3	60/50	240-480/230-460
**3	125	General Motors 6016-E	1200/1000	75/62.5	60/50	General Elec	3	60/50	127/220-230/400
1	100	International UD-18	1200	62.5	50	Westinghouse	3	60	240
**1	90	General Motors 6-71	1200	. . .	60 KW	Delco DC	.	.	120/240
**2	52	International UD-14	1200/1000	37.5/32.5	30/25	Elec. Mchnry.	3	60/50	127/220-230/400
**3	36/30	International UD-9	1200/1000	23/18.75	18.75/15	Elec. Mchnry.	3	60/50	240/440/127-220
1	79	Caterpillar D4500	1200	37.5	30	Ideal	3	60	220

* One plant Consisting of Three Units, i.e. 65, 150, and 200 KW.
** New units (all other units used).

Diesel Motors
PORT WASHINGTON, L. I., N. Y. **CORPORATION** TEL: PORT WASHINGTON 7-2000

230 volt DC Series Crane Hoist Motors

	MODEL	HP	RPM
(1) CO 1808-A2	90321	25	725
(1) CO 1808	90277	25/31	650—725
(1) CO 1809	90281	35/45	650—725
(1) CO 1809	90325	35	650
(1) CO 1829	90783	50	750
(1) CO 1810	90126	50	725
(1) CO 1829	23B361	50/65	675—750

Many other ratings available. Large stock of AC motors.

Transformers — Pumps — Mine Locomotives — Hoists and other items of Electrical and Mechanical Equipment.

Send your inquiries and lists of items for disposal.

E. P. DIETRICK
829 Richmond St. Scranton 9, Pa.

CONSULT US FOR

Diesel Gasoline and Steam Generators, Electrical and Industrial Equipment

POWERITE CORPORATION
140 Cedar St. New York 6, N. Y.
DEPT. 105 BA 7-8199

FOR SALE

AIR COMPRESSOR

1100 cu. ft. 100 lbs. chg. Pnu. 2 stage dir. con. 215 H.P. Westgh. Syn. Motor 2200/3/60 complete.

MOORHEAD ELECTRICAL MACHINERY CO.
Mayflower 7900 Pittsburgh 19, Pa.

FOR SALE

One 500 KVA Burk 230 Volt, 60 Cycle, 3 Phase Alternator, direct connected to a Ball non-releasing Corliss Engine. Unit is still in operation, and will be released April 1st.

FS-7886 POWER
520 N. Michigan Ave., Chicago 11, Ill.

TRANSFORMERS

MOTORS—GENERATORS—MOTOR GENERATOR SETS

WORLD'S LARGEST INVENTORY

PARTIAL STOCK LIST AS OF MARCH 1, 1949

60 Cycle—Oil Type Transformers

QUA.	KVA.	P.V.	S.V.	Phase	QUA.	KVA.	P.V.	S.V.	Phase
2	3900	23000	(25 cy) 2300	3	3	333	13800	115/230	1
	1500	2300	600	3	3	333	13800	2300	1
	1000	2300	230	3	3	333	2300	115/230	1
3	633	33000	2300	1	3	250	2300	230/460	1
	750	2300	2300	2/3	3	200	4600	115/230	1
6	500	12000	2300	1	3	200	7200	230/460	1
3	500	7200	230/460	1	3	200	2300	230/460	1
3	500	13800	230/460	1	3	200	2300	115/230	1
3	500	2300	230/460	1	3	150	13800	115/230	1
3	500	23000	440	1	3	150	2300	230/460	1

872 Smaller Ratings—Also Large Stock 25 Cycles and new Air-Cooled Transformers

Send Us Your Inquiries For
Motors, Generators, Motor Generator Sets
Immediate Shipment from our Large Stock—All Ratings
$ $ Cash for your Surplus Transformers $ $

Electric Equipment Co., Rochester 1, N. Y.

SEARCHLIGHT SECTION

FOR SALE

4000 KW TURBINE GENERATING PLANT

Consisting of

1—2000 KW and 2—1000 KW General Electric, 3 phase, 60 cycle, 480 Volts, 3600 R.P.M. Condensing Turbo Generator Units. Complete with all Auxiliaries. General Electric inspection reports are available.

A. G. SCHOONMAKER CO., INC.

50 CHURCH ST. Digby 9-4350 NEW YORK 7, N. Y.

2—480 H.P. Springfield Sectional Header Boilers 250# Super-Heaters
All Power Plant Equipment.

2—90 H.P. 125# cyclotherim. Package units.

We Are Specialists in Power Plant Engineering and Installation Work

WARNER J. SHERB, INC.

342 Madison Ave. Murray Hill 2-9098 N. Y. 17, N. Y.

POWER EQUIPMENT

BOILERS — ENGINES — DIESELS — TURBO-GENERATORS—M G SETS TRANSFORMERS—SWITCH-GEAR MOTORS

List with us for Sale your available equipment.

50,000# B. & W. Integral Furnace Boiler 400# Pulverizer & Accessor. Operated 6 days.

B. & W. WILL RE-ERECT AND SERVICE!

65,000# Griscomb-Russell Evaporator System, 1500 KW Non-Cond. GE Turbo-Generator, 210#—20#BP—440V—3600 RPM. & Swbd.

D. Merrill—Member Western Society of Engineers

MERRILL and COMPANY

407 S. Dearborn St., Chicago 5, Ill. • HArrison 7-8289

FOR SALE

Pennsylvania Oilfree Carbon Ring Air Compressor, Class 3 ATC, size 14 x 13, rated at 435 cu. ft. capacity at 100 lbs. working pressure. Motor driven with 100 h.p. Westinghouse line start motor, 440 volt, 60 cycle, 3 phase, mounted on compressor for V-belt drive. Equipped with Westinghouse automatic starter, Type A. Compressor was used only two months. Price $5,600.00 on foundation at power plant. Contact

THE GEO. WIEDEMANN BREWING CO., INC.
601 Columbia St., Newport, Ky.

FOR SALE

1000 KW Westinghouse Turbine; 3 ph-60 cy-2300 volt; 180# Steam pressure; 50° Superheat; straight condensing. Worthington vacuum pump included. Available immediately.

Ingersoll-Rand Class PRE 25x15 ¾x18 air compressor; 270 HP synchronous motor; 3 ph-60 cy-440 volts. Complete with starting gear exciter and spare parts. Tip-top shape. *Available immediately.*

EVANS PRODUCTS COMPANY
Western Division, Coos Bay, Oregon

FOR SALE

One 125 H.P. Cyclotherm steam generator built for 125# steam working pressure and arranged for operation with No. 6 oil, gas ignition with 220 volt 60 cycle, 3 phase alternating current.

This generator was originally built in 1947 and is in operation at the present time. It may be inspected at the plant of the Colonial Preserves, 1700 Elmwood Avenue, Buffalo, New York. Address ESTATE of A. J. ABELS, Robert S. Abels and Ward B. Arbury, Executors, 804 Morgan Building, Buffalo 2, New York.

FOR SALE

One 350 HP Model VD-MH 8 cylinder 4 cycle Superior full diesel engine; Fairbanks-Morse diesel units 60 HP up to 600 HP with clutches or generators; Gas engines, high or low speed, with or without generators; Steam engine generating units 75 KW up to 450 KW. Write me your needs.

A. C. ASKEW, Box 3073
Whittier Station, Tulsa 8, Oklahoma. Phone 6-6120

FOR SALE

Dynometer, 1000 HP at 2000 RPM for measuring Horsepower Output of engines or motors. Consisting Reynolds-Froude Dynometer, accurate scales and accessories $900

Detroit Rocking Electric Arc Furnace 60 lb. capacity, with transformer and controls for laboratory or small foundry production $400

FS-7980, POWER
330 W. 42nd St., New York 18, N. Y.

---

125 H.P. MOTOR

Westinghouse, 550 volt 1100 R.P.M. D.C. 60 cycle Perfect condition. Used in conjunction with Platt centrifugal Fire Pump. Capacity 1000 Gal. per minute.

Will sell complete or in part

HARRIS WRECKING CO.
1963 W. 3rd Street Cleveland, Ohio

POWER PLANT

FOR SALE — STILL INSTALLED

3—150 HP—150 lbs pressure boilers
1—500 HP Steam Engine with all accessories

FOR SALE — STILL INSTALLED
FS-7473, POWER
330 West 42 St., New York 18, N. Y.

FOR SALE

One C.E. spreader stoker, 8'6"x10'2", two unit, used one year. New condition, and priced to sell. Reason for selling, changed to gas. UNIVERSITY OF COLORADO MEDICAL CENTER, c/o J. A. McInnis, 4200 East 9th Avenue, Denver, Colorado.

IF THERE IS

Anything you want

that other readers of this paper can supply

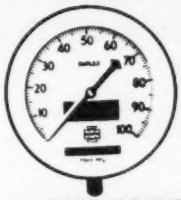
OR—

Something you don't want

That other readers can use, advertise it in the

SEARCHLIGHT SECTION

PRESSURE GAUGES



BAKELITE CASES

U.S. Crosby, Ashcroft, Champion, Lonergan, Certified, Marsh

BACK CONNECTIONS

0-100, Oil (Rochester)	.50 ea.
0-30, 0-60, 0-100, 0-500, 4½" Dial	3.75 ea.
0-1000, 4½" Dial	4.50 ea.

BOTTOM CONNECTIONS

0-15, 2" Dial (Marsh)	.60 ea.
0-400, 0-600, 4½" Dial	3.75 ea.
0-800, 0-1000, 0-2000, 0-3000 4½" Dial	4.50 ea.
0-200, 0-300, 0-400, 0-600, 0-800, 0-1500, 0-2000, 0-5000, 8½" Dials	5.75 ea.

ALSO some Vacuum & Vacuum Pressure Gauges 4½" & 8½" Dials.

All gauges are New, in Excellent Condition and mostly in original packing. Send check or money order, postage prepaid. Also C.O.D. or Net 10 days F.O.B. New York to rated concerns. Write for quantity prices & dealers discounts.

WALDEN INDUSTRIES, INC.
74 West 52nd St., New York 19, N.Y.
Tel. PL. 3-8595

FOR SALE
HYDRO-ELECTRIC GENERATING UNITS
AVAILABLE SOON

2—705 KVA 2300 V. 3 phase 60 cycle Fort Wayne generators direct connected to horizontal shaft, double opposed Francis type turbines manufactured by Pelton. Rated at 45 foot head. Woodward governors. Belt driven exciters. Installed in 1911.

1—1875 KVA 2300 V. 3 phase 60 cycle Westinghouse vertical shaft generator, driven by Wellman-Seaver-Morgan turbine. Rated at 49.4 foot head. Woodward governor. Installed in 1924.

1—Motor-generator set.

Essential switchboard equipment.

Now operating and available for inspection

Scheduled for permanent shut-down in May 1949 to make room for Higher Head Automatic Plant. *Address inquiries to*

R. B. BOALS, Supt.
EUGENE WATER BOARD
EUGENE, OREGON

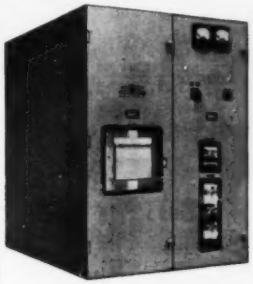
FOR SALE

MODERN 1000 KW Turbo-Generator

in Excellent Condition

Non-Condensing, Steel case 80# back pressure .8 P.F., 3 phase, 60 cycle, 4150/2300 volts, alternating current, complete with accessories, switchboard, oil circuit breaker, and direct connected exciter. Only operated alternately for six years. Ideal for Chemical, Rubber, Petroleum, Textile, Pulp and Paper, and Sugar Refining Industries.

NEWMAN & COMPANY, INC.
739 Drexel Building Philadelphia, Pa.



New! GENERAL ELECTRIC
VERTICAL LIFT TYPE M1-6 SWITCHGEAR

9 UNITS incorporating
GE Type FK255-500 . . . 2000 Amp . . 15000 Volt . . 250 Volt DC Solenoid Operated Breakers.

4 UNITS incorporating
GE Type FK255-150 . . . 1200 Amp . . . 15000 Volt . . . 250 Volt DC Solenoid Operated Breakers.

49 UNITS incorporating
GE Type FK255-150 . . . 600 Amp . . . 15000 Volt . . . 125 Volt DC Solenoid Operated Breakers.

for
FEEDERS
INCOMING LINE
GENERATOR CONTROL
INDUCTION MOTOR FULL VOLTAGE STARTING
INDUCTION MOTOR REDUCED VOLTAGE STARTING
SYNCHRONOUS MOTOR LINE STARTING

JOSEPH *Satin* COMPANY
ELECTRICAL EQUIPMENT
1 JORALEMON ST. BROOKLYN 2, N. Y. TRIANGLE 5-0433

2000 K. W.
STEAM POWER PLANT

Complete Power Plant Delivering
6300 Volts 3 phase
50 CYCLES
With Power Transformers to Step Up and Down 6300/35000 Volts and 6300/400 Volts

Packed for Export in Original Crates

Complete Specifications and Details Upon Request

International Fermont Machinery Co., Inc.
115 BROADWAY NEW YORK 6, N. Y.

TURBO GENERATOR FOR SALE

1250 KVA Turbo-Generator G.E. Curtis Type—now in operation—may be inspected by appointment. Available after April 1, 1949. Extraction type. 2 phase 60 cycles 240 volt, 3600 R.P.M. Direct connected exciter, 180 lbs., initial steam pressure, 5 lbs. extraction, complete with switchboard condenser and all auxiliaries.

RUSSELL BURDSALL AND WARD BOLT AND NUT CO.
PORT CHESTER, N. Y.

ADVERTISERS' INDEX

Where an * appears after a name the advertisement does not appear in this issue, but appeared in preceding issues

Air Express Div., Railway Express Agency 162
Air Preheater Corp. 215
Allen-Sherman-Hoff Co. 127
Allis-Chalmers Mfg. Co. 18-19, 39, 46
Allpax Co. 190
American Blower Co. 58
American Brass Co. 137
American Chain & Cable Co. 177
American Chimney Corp. 276
American District Steam Co. *
American Engineering Co. 269
American Pulverizer Co. 266
Ames Iron Works 242
Anchor Packing Co. 55
Arkansas Fuel Oil Co. *
Armstrong Cork Co. 173
Armstrong Machine Works 155
Associated Research, Inc. *
Atlas Valve Co. *
Aurora Pump Co. *

Babbitt Steam Specialty Co. 218
Babcock & Wilcox Co. 4-5
Bailey Meter Co. 12-13
Baldwin-Duckworth Div. of Chain Belt Co. 135
Baldwin-Hill Co. 267
Bartlett & Snow Co., C. O. *
Beaumont Birch Co. 194
Belco Industrial Equipment Co. 196
Bell & Gossett Co. *
Belmont Packing Co. *
Bernitz Furnace Appliance Co. 219
Betz Co., W. H. & L. D. 133
Biddle & Co., James G. 225
Bigelow-Liptak Corp. 234
Birch Mfg. Co. 276
Bird-Archer Co. *
Black, Sivalls & Bryson Co. *
Blaw-Knox Co. *
Boiler Tube Co. of America 274
Boston Woven Hose & Rubber Co. *
Bridgeport Brass Co. 253
Bros Boiler & Mfg. Co., Wm. *
Brown Instrument Co. 213
Buell Engineering Co. 174
Buffalo Forge Co. 30-31
Buffalo Pumps, Inc. 217
Bussmann Mfg. Co. 50-51
Byers Co., A. M. 70

Carborundum Co. 181-182
Cardox Corp. *
Cash Co., A. W. 258
Catawissa Valve & Fittings Co. 160
Chapman Valve Mfg. Co. 159
Chase Brass & Copper Co. 262
Chesterton Co., A. W. 166
Chicago Metal Hose Corp. 246
Chicago Pneumatic Tool Co. *
Cities Service Oil Co. *
Clarage Fan Co. *
Clark Bros. Co., Inc. 213
Cleaver-Brooks Co. *
Cochrane Corp. 54
Coffin Jr. Co., J. S. 178
Combustion Engrg.-Superheater, Inc. 20-21
Coppus Engineering Co. *
Crane Co. 139
Cryer Trap & Valve Co. 206

Dampney Co. of America 184
Darling Valve & Mfg. Co. *
Dart Mfg. Co., E. M. 170
Davis Engineering Co. 255
Davis Regulator Co. 200
DeLaval Separator Co. 169
DeLaval Steam Turbine Co. 66, 218
Detroit Stoker Co. *
Diamond Power Specialty Co. 8-9
Dings Magnetic Separator Co. *
Dodge Mfg. Co. 176
Dowell, Inc. 157
Dravo Corp. 151, 196
Drew Co., Inc., E. F. 195
Dudgeon, Inc., Richard *

Economy Pumps, Inc. *
Edward Valves, Inc. 40-41
Eisler Engineering Co., Inc. 224
Electric Machinery Mfg. Co. 248
Electric Storage Battery Co. *
Elgin Softener Corp. 211
Elliott Co. 6-7
Engineer Co. 256
Erie City Iron Works 250
Ernst Water Column & Gauge Co. 276

Fairbanks-Morse & Co. 209
Fairfield Engineering Co. 191
Fairmont Coal Bureau *
Fisher Governor Co. 233
Flexo Supply Co., Inc. 278
Fluor Corp., Ltd. 26-27
Flynn & Emrich Co. *
Foster Engineering Co. 261
Foster Wheeler Corp. 36-37
Foxboro Co. 238
Frick Co. *
Fuller Co. *

Garlock Packing Co. *
General Coal Co. *
General Electric Co.
(Apparatus Dept.) 10-11, 34A-34B
Gifford-Wood Co. 171
Globe Steel Tubes Co. 191
Golden-Anderson Valve Spec. Co. 231
Goodyear Tire & Rubber Co. 65
Goulds Pumps, Inc. 172
Graver Tank & Mfg. Co. 221
Grinnell Co. Third Cover
Griscom-Russell Co. 60
Gulf Oil Corp. 61
Gulf Refining Co. 61
Gunite Concrete & Construction Co. 196

Haering & Co., D. W. *
Hagan Corp. 56-57
Hall Laboratories 265
Harbison-Walker Refractories Co. 203
Haynes Stellite Co. *
Hays Corp. 273
Hays Institute of Combustion 224
Heacon, Inc. 254
Hendrick Mfg. Co. 206
Hensley Co. 218
Hewitt Rubber Div. Hewitt Robins, Inc. 179
Hill Pump Valve Co. 276
Hoffman Specialty Co. *
Homestead Valve & Mfg. Co. 240
Honan-Crane Corp. *
Hoppes Mfg. Co. 272

Illinois Water Treatment Co. *
Infilco, Inc. 235
Ingersoll-Rand Co. 228
International Nickel Co. 52
International Textbook Co. 216

Jefferson Union Co. 216
Jeffrey Mfg. Co. 187
Jenkins Bros. 144-145
Jerguson Gage & Valve Co. *
Johns-Manville, Inc. 149
Jones Foundry & Machine Co., W. A. 272
Joy Mfg. Co. 252

Keasbey & Mattison Co. 38
Kellogg Co., M. W. 223
Kennedy Valve & Mfg. Co. 192
Kennedy-Van Saun Mfg. & Engrg. Corp. 14-15
Kewanee Boiler Corp. 309
Klingerit, Inc. 207
Klipfel Mfg. Co. *
Koppers Co., (Coupling Dept.) 189

Ladish Corp. 163
Leeds & Northrup Co. Second Cover
Link-Belt Co. 3
Liquidometer Corp. 278
Lummus Co. *
Lumnite Div., Universal Atlas Cement Co. *
Lunkenheimer Co. 44-45

Manheim Mfg. & Belting Co. *
Manning, Maxwell & Moore, Inc. 270, 274
Manzel, Inc. *
Marley Co. 164
Marsh Corp., James P. *
Mason-Neilan Regulator Co. 210
Maxim Silencer Co. *
McGraw-Hill Book Co. 212, 224
Midwest Piping & Supply Co. 245
Minneapolis-Honeywell Reg. Co. 249
Mitchell & Co., W. K. 237
Modine Mfg. Co. 201
Monsanto Chemical Co. 165
Murray Iron Works Co. 271

National Aluminate Corp. 143
National Tube Co. 251
National Valve & Mfg. Co. 260
Niagara Blower Co. *
Nicholson Co., W. H. 216
Nordberg Mfg. Co. 263
Northern Equipment Co. 147
Norton Co. 244
Nugent & Co., Inc., W. W. 204

Oakite Products, Inc. 212
Ohio Coal Association 167
Ohio Injector Co. 227

Peabody Engineering Co. 226
Penn Flexible Metallic Tubing Co. *
Pennsylvania Crusher Co. *
Permutit Co. *
Petro-Chem Development Co., Inc. *
Philadelphia Gear Works 264
Pipe Fabrication Institute *
Pittsburgh Piping & Equipment Co. 277
Pittsburgh Steel Co. *
Pittston Company 193
Plibrico Jointless Firebrick Co. 275
Powell Co., Wm. 32-33
Powers Regulator Co. 270
Prat-Daniel Corp. 239
Preferred Utilities Mfg. Corp. 236
Pritchard & Co., J. F. *

Quaker Rubber Co. *

Raybestos-Manhattan, Inc. Packing Div. 259
Reading, Pratt & Cady Div. 177
Reliance Gauge Column Co. 247
Republic Flow Meters Co. 28-29
Republic Rubber Div., Lee Tire & Rubber Co. 257
Republic Steel Corp. 42-43
Research Corp. 232
Revere Copper & Brass, Inc. 141
Richardson Scale Co. *
Ric-Wil Co. *
Riley Stoker Corp. 104-105
Robins Conveyors Div., Hewitt Robins, Inc. 179
Roto Div. of Elliott Co. 202

Sarco Co. 175
Schramm, Inc. 180
Schutte & Koerting Co. *
Shaw Co., B. F. 35
Sier-Bath Gear & Pump Co. 186
Sinclair Refining Co. *
Skinner Engine Co. 214
Smith Refractories, Sanford S. *
Socony-Vacuum Oil Co. *
Springfield Boiler Co. 53
Standard Oil Co. of Indiana 16-17
Steel & Tubes Div. 42-43
Stephens-Adamson Mfg. Co. 34
Stickle Steam Specialties Co. 222
Stone & Webster Engrg. Co. *
Strong, Carlisle & Hammond Co. 168
Struthers Wells Corp. 185
Sturtevant Div., Westinghouse Electric Corp. 62-63
Sun Oil Co. 131
Superior Combustion Industries 153
Swartwout Co. 310
Sweet's Catalog Service 186, 198, 220

Taylor Forge & Pipe Works 241
Taylor Instrument Co's *
Terry Steam Turbine Co. 229
Texas Co. Back Cover
Thermix Corp. 239, 254
Tidewater Associated Oil Co. *
Timken Roller Bearing Co. 161
Todd Shipyards Corp., Combustion Equipment Div. 220
Trimont Mfg. Co. 197
Troy Engine & Machine Co. 208
Trumbull Electric Mfg. Co. 183
Tube-Turns, Inc. 230

Union Carbide & Carbon Co. *
Union Iron Works *
U. S. Steel Corp. 251

Viking Pump Co. 190
Vogt Machine Co., Henry 47
Vulcan Soot Blower Corp. 24-25

Wallace & Tiernan Products, Inc. *
Walworth Co. 64
Warren Steam Pump Co. *
Watson-Stillman Co. 199
Western Electrical Co. 188
Westinghouse Electric Corp. 68-69, 108-109
Weston Electrical Instrument Corp. *
Wheeler Mfg. Co., C. H. 48-49
Where to Buy 276
Wickes Boiler Co. 59
Wiedeke Co., Gustav *
Williams Gauge Co. *
Wing Mfg. Co., L. J. *
Worthington Pump & Machy. Corp. *
Wright Chemical Co. 198

Yarnall-Waring Co. 22-23, 129
Youngstown Sheet & Tube Co. 265

Zallea Bros. *

Extra STRENGTH for Heavy Duty
KEWANEE
• Extra stout stays and braces add further strength to the sturdy steel construction.
10 to 304 H. P.
100, 125, 150 lbs. W. P.
Has all the characteristics which make firebox boilers especially adapted for high pressure.
75 Years Boilermakers
For 6" scale with pipe diameter markings... WRITE Dept. 95-K3
KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS

PROFESSIONAL SERVICES 276

SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT
Positions Vacant 279
Selling Opportunities Offered 279
Employment Services 279
Positions Wanted 280
Selling Opportunities Wanted 280

SPECIAL SERVICES 280

EQUIPMENT
(Used or Surplus New)
For Sale 280-307

WANTED
Equipment 280

ADVERTISERS INDEX
Abels, Estate of A. J. 306
Aljon Electric Diesel Co. 295
American Air Compressor Corp. 292
Arrow Transformer Co. 299
Askew, A. C. 306
Atlantic Transformer Co. 302

Bauer, L. W. 280
Beeson Engineering Co. 298
Belyea Co., Inc. 283, 300
Berger Bros. Electric Motors Inc. 302
Bloedel, Stewart & Welsh Ltd. 305
Boswick Electric Co. 293
Brearley, H. P. 298
Brew-Woltman & Co., Inc. 292

C & S Machinery 301, 303
Carthage Hydrocol Inc. 279
Chicago Electric Co. 294
Colorado, University of 306
Consolidated Cement Corp. 300
Corn Belt Power Cooperative 279
Cornell University 304
Cusac & Associates Inc. F. L. 290

Darien Corp 298
Denny & Clark 301
Diesel Motors Corp. 305
Dietrick, E. P. 305
Douglass Co., Stephen A. 302
Duquesne Electric & Mfg. Co. 285

Electric Apparatus Repair Co. 299
Electric Equipment Co. 305
Electric Generator & Motor Co. 295
Electric Service Co., Inc. 295
Ellis Co., A. Lee 298
Empire Electric Co., Inc. 296
Erie Electric Co., Inc. 297, 300
Evans Products Co. 306
Eugene Water Board 307

Fletcher Sales Co. 304
Fitzgibbons Boiler Co., Inc. 304

Glow Electric Co. 288

Hall & Co., Stephen 302
Harris Wrecking Co. 306
H & P Machinery Co. 303
Heat & Power Co., Inc. 301
Hemphill & Co., J. L. 281
Hercules Elect. Machy. & Equip. Co. 301
Howe Brothers 303

Independent Electric Machy. Co. 302
Industrial Equipment Co. 280
Industrial Trading Co. 304
Ingfa Myren & Co. 280
International Fermont Machinery Co., Inc. 303, 307
International Power Machy. Co. 297

Johnson & Assoc., Howard Blain 304

Keystone Power Plant Equip. Co. 292
Kiemle Co., Fred W. 300
Kirk Co., Wallace E. 295

Land, L. J. 284
Louisville Cooperage Co. 280

Mahoney-Clarke Inc. 280
Merrill & Co. 306
Midwest Mfg. Co. 302
Mississippi Valley Equipment Co. 292
Moorhead Electrical Machy. Co. 305

Neiswander, Robert L. 303
Neu Corp., Hugo 291
Newman & Co. 307
Northern Metal Co. 298

Parenteau, N. F. 280
Penn Machinery Co. 304
Pennsylvania Power & Light Co. 279
Powerite Corp. 305
Power Plant Equipment Co., Inc. 305

Rearick, Charles B. 299
Russell Burdsall & Ward Bolt & Nut Co. 307

Sandman Electric Co., Inc. 300
Satin, Joseph 307
Schoonmaker Co., Inc., A. G. 282, 301, 306
Sherb Inc., Warner J. 306
Stewart, Paul 296

Thompson Co., Inc., J. Parker 299

Universal Wire & Cable Co. 280
Utilities Electrical Machy. Corp. 286

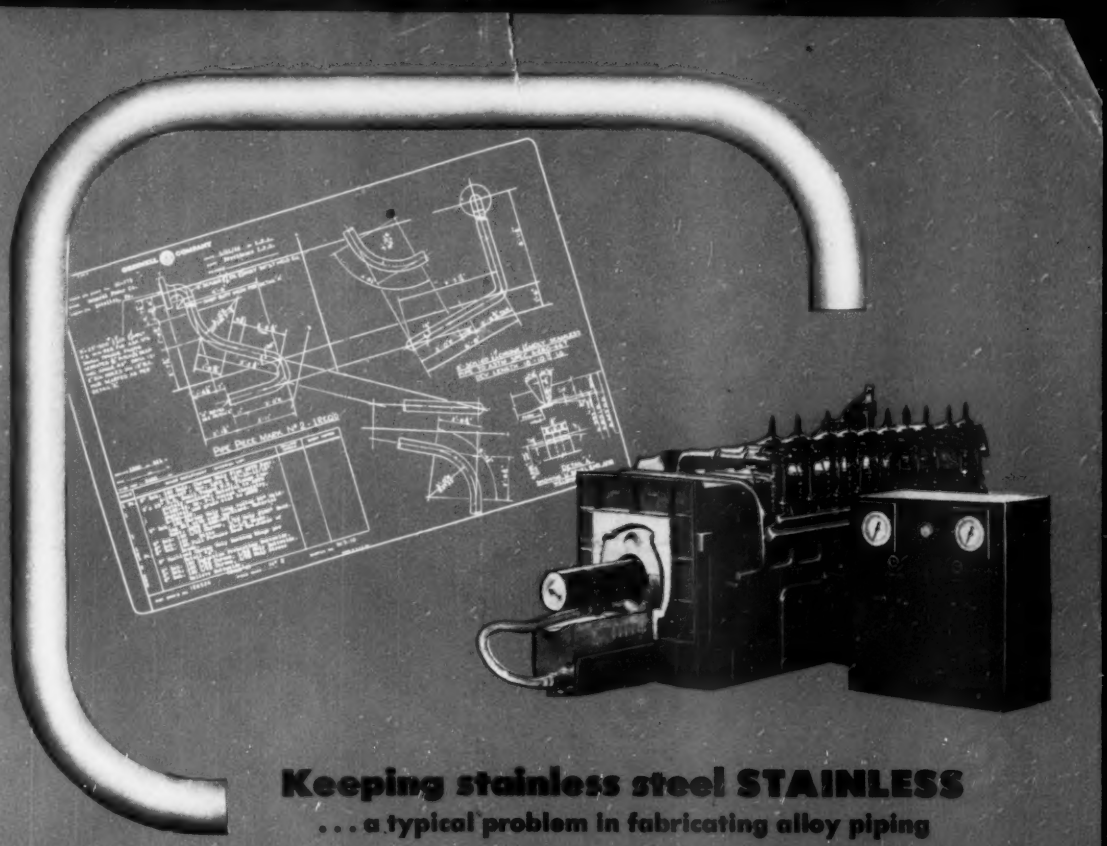
W. J. M. 302
Wagner Co., Arthur 289
Walden Industries Inc. 307
Weaver & Co., Charles 287
Werby & Co. 304
Wiedemann Brewing Co., Geo., The 306
Wilms & Co., Walter H. 294
Wurth Electric Motor Co. 302

Swartwout ANNOUNCES

New *influence method* Feed Water Regulation Systems for higher pressure boilers

A new and different approach to this vital control function brings greater operating safety to quick-changing water levels

● Utilizing fundamental principles not heretofore applied to feed water regulation, Swartwout presents latest controls in single, double and triple-element systems to handle any regulation problem. Designed primarily for the rapid level changes inherent in modern high pressure boilers, these systems give you feed water level maintenance during all load changes by means of an *exclusive influence method* (patent applied for) found only in the new Swartwout Controls. They reflect Swartwout's 40 years experience in feed water regulation. Write for Bulletin S-27.



Keeping stainless steel STAINLESS

. . . a typical problem in fabricating alloy piping

Heat a piece of stainless steel pipe to bend it and right away you're up to your ears in metallurgical complications. To begin with, stainless steel isn't just one alloy. There are hundreds of different types of stainless steel, each selected for its resistance to corrosion or its stability at high temperatures. To maintain the metallurgical properties which dictate the choice of a particular alloy steel, you have to know the temperature range within which this steel may suffer excessive metallurgical changes. And you have to have specialized equipment to maintain the precise control necessary to avoid these hazards.

Grinnell pipe fabrication equipment includes specially designed gas-fired radiant heat furnaces for this precisely controlled heat treatment of stainless steels and other alloy steels. Multiple burners are strategically located to distribute temperature uniformly and to prevent harmful flame impingement. Precision instruments regulate temperature and time.

It's an intricate business . . . fabricating alloy steel piping. It's a job for Grinnell prefabricating plants because Grinnell has the equipment and modern methods, the interpretive engineering, the metallurgical research facilities and the skilled personnel.

GRINNELL

Grinnell Company, Inc., Providence 1, Rhode Island. Branches: Atlanta • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston
Long Beach • Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

protect your POWER OUTPUT

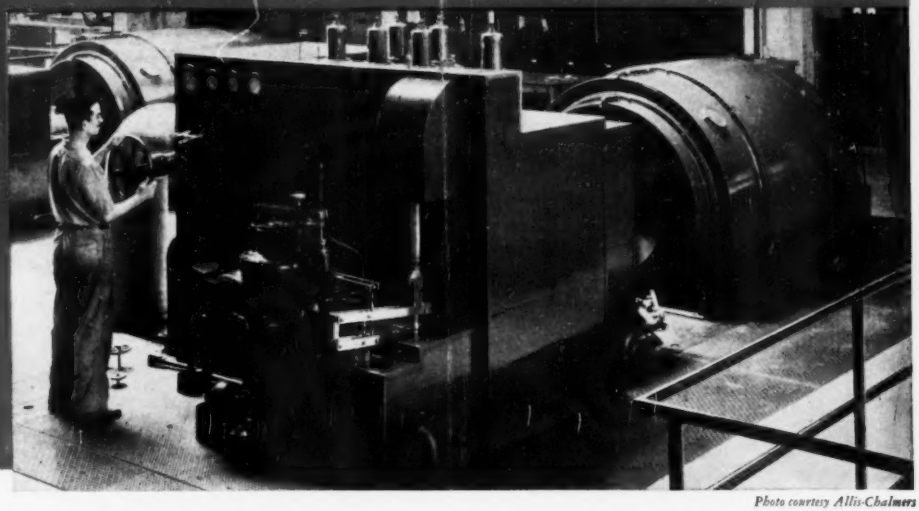


Photo courtesy Allis-Chalmers

Keep your turbines on the line with Texaco Regal Oils (R&O) They provide an extra margin of safety

WITH high power demands still forcing many turbines to be run continuously under heavy load, this is no time for power failure. Keep your turbines on the line by protecting them with *Texaco Regal Oils* (*R & O*)—the oils with *an extra margin of safety.*

Texaco Regal Oils (*R & O*) contain powerful rust and oxidation inhibitors, and are specially processed to prevent foaming. They keep circulating systems *clean*—free of harmful sludge... assure normal bearing temperatures, instantly responsive governor action. They protect all parts against wear—give extra long oil service life.

The use of *inhibited* oils is strongly recommended by turbine manufacturers, and *Texaco Regal Oils* (*R & O*) meet the stringent requirements of all leading turbine builders, and the turbine oil specifications of the U. S. Navy.

Let a Texaco Lubrication Engineer help increase efficiency in your plant through more effective lubrication. Call the nearest of the more than 2300 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Regal Oils (R&O)

FOR ALL TURBINES

Tune in...TEXACO STAR THEATRE presents MILTON BERLE every Wednesday night. METROPOLITAN OPERA broadcasts every Saturday afternoon.